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ABSTRACT

This second interim report on the feasibility of a United States changeover to a metric system stems from the U.S. Metric Study, which was authorized by Public Law 90-472, and was prepared by the National Bureau of Standards to provide a better basis for Congressional evaluation of this issue. Participating in this national survey were 55 federal agencies, of which over half of their individual responding subunits were already using the International System of Units called the SI measurement units or SI-based engineering standards. In spite of the substantial costs involved during a conversion period, 48 of the 50 affected expect long-term advantages to outweigh disadvantages for them, and 39 agencies support a coordinated national effort to increase use of the metric system in the United States, with only one agency in opposition to the idea. The areas of federal responsibility already seriously affected by the current national level of metric system use are: (1) automobile safety, caused by the influx of metric-dimensioned foreign vehicles and components, and (2) the shipbuilding functions of the U.S. Coast Guard. Increased problems in the "area of national responsibility" are expected by over a third of the 57 responding agencies if a "laissez faire" government policy continues. Extensive resource materials are appended, including a glossary, responses to survey questionnaires, and legal problems attendant on national conversion to SI units. (AG)

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U.S. METRIC STUDY
INTERIM REPORT

FEDERAL GOVERNMENT: CIVILIAN AGENCIES

U.S. METRIC STUDY

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BS SP 345-2

U.S. METRIC SUBSTUDY REPORTS

The results of substudies of the U.S. Metric Study, while being evaluated for the preparation of a comprehensive report to the Congress, are being published in the interim as a series of NBS Special Publications. The titles of the individual reports are listed below.

REPORTS ON SUBSTUDIES

NBS SP345-1: International Standards (issued December 1970, SD Catalog No. C13.10:345-1, price $1.25)

NBS SP345-2: Federal Government: Civilian Agencies (this publication)

NBS SP345-3: Commercial Weights and Measures (in press)

NBS SP345-4: The Manufacturing Industry (issued July 1971, SD Catalog No. C13.10:345-4, price $1.25)

NBS SP345-5: Nonmanufacturing Businesses (in press)

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NBS SP345: To be published in August 1971

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U.S. METRIC STUDY INTERIM REPORT

FEDERAL GOVERNMENT: CIVILIAN AGENCIES

Second in a series of reports prepared for the Congress

U.S. METRIC STUDY
Daniel V. De Simone, Director

National Bureau of Standards
Special Publication 345-2

UNITED STATES DEPARTMENT OF COMMERCE
Maurice H. Stans, *Secretary*
NATIONAL BUREAU OF STANDARDS
Lewis M. Branscomb, *Director*

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LETTER OF TRANSMITTAL

THE HONORABLE PRESIDENT OF THE SENATE
THE HONORABLE SPEAKER OF THE HOUSE OF REPRESENTATIVES

SIRS:

I have the honor to present the second in the series of interim reports stemming from the U.S. Metric Study, prepared by the National Bureau of Standards.

This Study was authorized by Public Law 90-472 to reduce the many uncertainties concerning the metric issue and to provide a better basis upon which the Congress may evaluate and resolve it.

I shall make a final report to the Congress on this Study in August 1971. In the meantime, the data and opinions contained in this interim report are being evaluated by the Study team at the National Bureau of Standards. My final report to you will reflect this evaluation.

Respectfully submitted,

Maurice H. Stans

Secretary of Commerce

Enclosure

LETTER OF TRANSMITTAL

Honorable Maurice H. Stans
Secretary of Commerce

Dear Mr. Secretary:

I have the honor to transmit to you another interim report of the U.S. Metric Study, which is being conducted at the National Bureau of Standards at your request and in accordance with the Metric Study Act of 1968.

The Study is exploring the subjects assigned to it with great care. We have tried to reach every relevant sector of the society to elicit their views on the metric issue and their estimates of the costs and benefits called for in the Metric Study Act. Moreover, all of these sectors were given an opportunity to testify in the extensive series of Metric Study Conferences that were held last year.

On the basis of all that we have been able to learn from these conferences, as well as the numerous surveys and investigations, a final report will be made to you before August 1971 for your evaluation and decision as to any recommendations that you may wish to make to the Congress.

The attached interim report includes data and other opinions that are still being evaluated by us to determine their relationship and significance to all of the other information that has been elicited by the Study. All of these evaluations will be reflected in the final report.

Sincerely,

Lewis M. Branscomb

Lewis M. Branscomb, *Director*
National Bureau of Standards

Enclosure

FOREWORD

All of the agencies of the Federal Government that could be significantly affected by a metric changeover participated in the U.S. Metric Study. This report brings together and records the views of these agencies (except the Department of Defense, which is covered in a separate report) on the basic questions raised by the Metric Study Act, Public Law 90-472.

Reports covering other substudies of the U.S. Metric Study are listed on the inside front cover. All of these, including this report, are under evaluation. Hence, they are published without prejudice to the comprehensive report on the entire U.S. Metric Study, which will be sent to the Congress by the Secretary of Commerce in August of 1971.

This report was prepared by a Metric Study team headed by Mr. Roy E. Clark, and including Mr. John M. Tascher, Dr. Joseph D. Crumlish, Mr. Joseph P. Alexa, Mrs. Jeanine Murphy and Mrs. Sandra Wean.

We are grateful to the 55 civilian agencies of the Federal Government that participated in this Survey and to the hundreds of individuals within these agencies who provided the information upon which this report is based.

In this as in all aspects of the U.S. Metric Study, the program has benefited from the independent judgment and thoughtful counsel of its advisory panel and the many other organizations, groups, and committees that have participated in the Study.

Daniel V. De Simone, *Director*
U.S. Metric Study

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I. INTRODUCTION AND SUMMARY

BACKGROUND

Use of a measurement system based principally on the meter, kilogram and second as fundamental units (technically known as the International System of Units, hereinafter referred to as SI) is well on the way to becoming universal in the world outside the United States. Recognizing this, the U.S. Congress in 1968 passed an Act (Public Law 90-472)[1] calling for an investigation of the present and future effects of increasing worldwide and domestic metric usage on various activities in the United States. Of the present major users of the English (our customary) system of measurement, Great Britain and South Africa are in the midst of 10-year national metric conversion efforts, and Canada, Australia and New Zealand have declared national policies of eventual conversion to the SI as their national measurement system.

The Congress in the Metric Study Act outlined a comprehensive investigation to cover diverse sectors of our society. This Survey of Federal Government Agencies has fulfilled one aim of the Act by ascertaining the present and expected future impacts of worldwide metrication on all likely affected agencies of the Federal Establishment[2] and on the constituent activities of their areas of responsibility in the society at large. The survey also obtained the views of the agencies with regard to the alternative courses of action open to the United States in an increasingly metric world.

EFFECTS ON INTERNAL OPERATIONS

Fifty-five Federal agencies participated in this Survey. The "effects on agency internal operations" part of the Survey is based on responses from some 394 individual subunits within 50 of the agencies. It was found that more than one-half of the individual responding entities are already involved with at least some use of SI measurement units, and in some cases with SI-based engineering standards. Such current usage occurs in connection with fields which are largely metric (e.g., electronics, pharmaceuticals), to enhance compatibility with scientific activities, to facilitate international interchange of goods (and of statistics), and to conform to certain U.S. industry practices. Most respondents currently using the SI reported that advantages stemming from their metric usage, such as improved operations, facilitated scientific intercourse, and improved international communications outweigh such disadvantages as lack of employee familiarity with the system and confusion as a consequence of dual usage.

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[1] The law, commonly referred to as the Metric Study Act, is included as app. 1 of this report.

[2] Except the Department of Defense, which is being covered by a separate study.

In view of the foreseeable trends in worldwide and domestic metric usage, one-fifth of the surveyed subunits expect to make increasing use of the SI in their work, whatever national policy is decided upon. Some respondents said they are being pushed in this direction by suppliers. Others will increase usage of SI in the interest of international communication and cooperation. Some plan to use the metric system more widely, simply for the benefits of easier calculations, reduced errors and the operational improvement that it brings. Fully 43 percent of the 394 subunits do not plan to expand their own use of the metric system, and do anticipate growing measurement-related difficulties. Expected difficulties in the absence of increased adaptation to worldwide metric usage include: confusion due to dual measurement system usage, increased training requirements, more measurement conversions and interfacings between parts designed in the two systems, larger dual inventories, and increasing international communications and cooperation difficulties.

A concerted program of U.S. metrication would (1) bring all the advantages of current metric usage listed above, (2) eliminate the disadvantages, once conversion is completed and (3) solve the problems imposed by the worldwide situation. However, there would be certain added costs of operation imposed on Federal agencies by the conversion effort. Even with conversion of measurement units alone, employees already on duty would have to be trained and the general populace familiarized with the new system, measuring instruments converted or replaced, publications revised, legislation involving specified weights or measures amended and some computer programs (e.g., air traffic control) rewritten. With conversion also of engineering standards to a rational SI base, there would be additional expenses for extra standards-developing activity, and for maintaining a degree of dual inventory of parts as long as customary-engineered equipment remains in use.

The Survey of Federal Government Agencies sought "best guess" estimates of what added costs might amount to, and what permanent annual savings might accrue after conversion. Although a few areas of uncertainty remain, it is believed that the Survey has obtained a good indication of the expected magnitude of such cost impacts. The annual added cost to the Federal budget (exclusive of the Defense Department) of a 10-year coordinated national metrication effort including revision of engineering standards would appear to be on the order of $58 million. For conversion to the metric measurement language only, the 10-year annual cost is estimated as $32.1 million. Put another way, the per capita cost to each U.S. citizen (1970 census figures) for the Federal Establishment (exclusive of the Defense Department) to accomplish its part of a coordinated national metrication effort, including revision of engineering standards, over a 10-year period would appear to total $3 at the outside. After completion of the transition (and indefinitely thereafter) annual dollar savings from complete metrication are expected to amount to $7.4 million (for the language-only conversion, to $4.3 million). Put another way, it would appear that 7 to 8 years of post-transition dollar savings would recover 1 year's transition costs. For reasons discussed in the report, these rates of discount of future benefits are probably high: costs are very likely overstated, and dollar benefits almost certainly understated.

In spite of the very real costs that would be involved, 48 of the 50 agencies expect that long-term advantages of a U.S. metric conversion would outweigh disadvantages from their point of view. Thus, it is not too surprising that 39 of the surveyed agencies support a coordinated national effort to increase use of the metric system in the United States. (An additional six agencies reported that they are not appreciably affected by the measurement system or engineering standards in use.) Opposition to coordinated U.S. metrication at the agency level was limited to one agency,[3] which had a majority of responding subunits opposed to the change.

Although the estimated costs to the Federal budget for a conversion of measurement units only are substantially less than for a conversion including engineering standards, a number of respondents felt the former move would impose permanent cost increases and operational impairment (due to the confusions of describing "customary" standards and equipment in the metric language), while for them conversion of both units and standards would bring cost decreases and operational improvement. Some respondents stated that conversion of measurement units only would be a less than half-way measure which would not solve the real problems (of equipment and product incompatibilities). Thus, strong feelings were expressed in some agencies that, if we abandon our *laissez faire* approach to metric usage, we should then go "all the way" and bring our engineering standards into line with the metric measurements.

A consensus of the individual responding entities favors 10 years as a reasonable time frame in which conversion of measurement activities in the U.S. to the use of SI units could be substantially completed. "Optimum" transition periods would vary for different kinds of activities. Because of this it would be essential to devise a carefully organized plan for coordination of conversion moves throughout the society.

EFFECTS ON AREAS OF NATIONAL RESPONSIBILITY

The current level of metric system use in this country has already seriously affected two areas of responsibility of the Federal Establishment: the functions of the U.S. Coast Guard with respect to shipbuilding (verification of compliance with safety and other standards), and the area of automobile safety. In the latter case the influx of metric-dimensioned foreign vehicles and components is requiring special tools for servicing and special blueprints for safety standards. Slightly over one-third of the 57 agency responses[4] in the "area of national responsibility" part of the Survey expect increasing measurement-related problems, which, in the absence of a concerted national metrication effort, will range up to substantial or serious with regard to their area of responsibility.

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[3] The Social Security Administration in the Department of Health, Education and Welfare.

Of these 57 agency respondents, 28 see U.S. metrication facilitating the activities within their areas of responsibility and their interactions therewith, 31 favor increased U.S. metrication (most endorsing a coordinated national program), and only one opposes any national program.

CONCLUSION

Thus, the Survey of Federal Government Agencies found substantial expectation of increasing problems in the Federal Establishment with continuation of a *laissez faire* policy toward metrication, and widespread feeling that a coordinated national effort to increase the use of SI measurement units and engineering standards in the U.S. is desirable. A broad consensus of the Federal agencies and responding subunits expect that the long-term advantages of such a move would clearly outweigh any short-term disadvantages, even including the substantial costs that would be involved during the conversion period.

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[4] Some agencies were asked for responses on several "areas of national responsibility" and some agencies were not asked for responses. Thus, the number of inputs to this part of the survey does not equate to the overall number of agencies covered.

II. NATURE OF THE SURVEY

Public Law 90-472, which authorized the U.S. Metric Study, directed that the Study "consult and cooperate with other government agencies, Federal, state, and local" in carrying out the investigation. A survey of Federal Government Agencies was therefore established to assess the effects of metrication on Federal Government functions. Other studies were established to determine the effects on the Department of Defense and on state and local governments. This report thus concerns Federal agencies other than the Department of Defense.

The Federal Government Survey ascertained the effects of metrication on (1) the internal operations of the participating agencies and (2) the areas of national responsibility of these agencies.

The first aim of the Survey, the impact of metrication on the internal operations of agencies, was to determine:

(1) the extent of present metric usage in government agencies;

(2) the impact of increasing worldwide use of the metric system on U.S. government programs;

(3) the extent to which Federal agencies plan to increase metric usage in the absence of a nationally planned metrication program;

(4) the impacts of metrication on the agencies under alternative nationally-planned programs to convert to the metric system;[1]

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[1] The study sought to determine the impacts of metrication on internal operations of the agencies under three different assumptions as follows (the assumptions are defined in greater detail within the sample copy of the questionnaire in app. 3. See particularly p. 58 and pp. 61, 62) (footnote continued in p. 6):

(5) how the agencies would introduce the metric system; and
(6) whether the agencies favor a coordinated metrication program.

The second aim of the Survey, the impact of metrication on agency areas of national responsibility, was to seek estimates of the effects of metrication on:

(a) national activities over which Federal agencies have responsibility (for example, transportation, communications); and
(b) the ability of the Federal agencies to perform their missions with respect to those "areas of national responsibility."

The Survey defined "area of national responsibility" as a "complex" or "system" such as transportation, food and fiber, or international affairs. Most such "systems" are largely within the private sector of the U.S. economy. Concerning areas of national responsibility, the study sought an agency's estimates of the present impact and probable future impacts of evolutionary measurement usage change or of planned metrication on the ability of the transportation system (for example) to function. Responses were sought under two different assumptions: (1) no national metrication effort, and (2) a nationally coordinated metrication program. The Survey also asked how metrication would affect the ability of the agency in performing its mission with respect to its area of national responsibility. Finally, the Survey asked the agencies what action should be taken with respect to the increasing worldwide and domestic use of the metric system. The Survey preferred that the opinions expressed be those of the agencies rather than those of the agencies' constituents (e.g., manufacturers). The U.S. Metric Study had other surveys designed to obtain the views of nongovernmental sectors.

These questions were aimed at providing estimates of impacts of metrication on the nongovernmental sector of society from the Government's viewpoint, a viewpoint not included in any of the other surveys within the Metric Study. Also they evaluate the impact of metrication on the interfaces between the Government and the areas of national responsibility over which it has cognizance.

It was decided early in the Survey that the questionnaire method was the most practicable approach to getting the needed information. Knowledgeable respondents within the agencies were asked to provide answers on the basis of "best judgment." It was recognized that the short time period would

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[a] *Assumption I.* No concerted national program to increase the use of the metric measurement units and/or metric engineering standards in a world of increasing metric usage.

[b] *Assumption II.* A nationally planned program to increase the use of SI metric measurement units (language only). After a 10-year period of transition, SI measurement units will be used throughout the U.S. in all new and revised documents except for describing existing customary hardware, replacement parts therefore, and interfaces therewith.

[c] *Assumption III.* A nationally planned program to increase the use of metric measurement units and metric engineering standards. Metric engineering standards, as well as metric measurement units, will be used for all new and redesigned products after a 10-year period of transition.

preclude any extensive research on the part of the respondents to obtain more comprehensive answers.

Costs were to exclude all added or reduced procurement and contracting costs, except "specialized hardware" designed to the buyer's specifications and not available off the shelf. Since the Metric Study considered the Federal Government as "a consumer of goods and services," these excluded increased costs were covered by other surveys such as the manufacturing industry survey. All other consumers would also have to pay these increased costs. In some cases, however, such as spacecraft purchases by the National Aeronautics and Space Administration (NASA) or nuclear devices by the Atomic Energy Commission (AEC), the contracting costs increases were included, since the Government is virtually the only purchaser.

The Federal Survey team selected for participation in the Survey only those government agencies which would probably be significantly affected by metrication. With this in mind, 35 departments and independent agencies were chosen. With the subagencies in some Departments (e.g., Maritime Administration in Commerce; Office of Education in Health, Education and Welfare; or U.S. Coast Guard in Transportation), the total number of surveyed agencies came to 55. As pointed out earlier, the Department of Defense was not included in this survey.

Letters were sent out on October 31, 1968 under the signature of the Secretary of Commerce to the heads of the 35 agencies asking them to appoint members of their staffs to provide liaison with the Federal Survey team. The team then met with each of the appointed liaison representatives to explain the scope and methodology of the Survey.

NASA was asked to be the subject of a pilot survey to test the effectiveness of the team's approach and its questionnaire format on an agency-wide basis. The questionnaires were sent out to the 10 NASA Centers on February 6, 1970, and the completed questionnaires were to be returned by March 10, 1970. The results from the pilot survey appeared to be satisfactory. Some changes were made in the questionnaire format as a result of suggestions.[2]

Once the pilot survey was undertaken, the liaison representatives were asked to provide lists of subdivisions in their agencies which they thought would be affected by metrication. Due to the lack of time and resources for eventual analysis of the questionnaire returns, the Survey team wanted to keep the questionnaires from proliferating. Therefore, the representatives were asked to confine their lists of respondents to only those groups which would be significantly affected by metrication, now or in the future. In some cases, therefore, only one respondent was chosen within a large bureau. The Federal Survey team thought that this rifle approach would more likely bring out the information it needed than the "shotgun" or the umbrella approach, where each bureau-level organization would provide input for its functions, whether any would be affected by metrication or not.

Included as respondents were those nongovernmental facilities which perform virtually all their work for the Government (for example, the Jet

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[2] See app. 3 for copies of the survey questionnaires.

Propulsion Laboratory of the California Institute of Technology for NASA, and the Sandia Laboratories of Sandia Corporation for AEC). However, grantees receiving grants from Federal agencies (such as NSF grants for scientific research) were not included, since purchases by these grantees will be covered by other surveys within the Metric Study. Programs of the state and local governments (even though part of the programs' funding may come from the Federal Government) were not included in the Federal Survey – examples of these are public school expenses and changing of highway signs on *completed* interstate roads – since these costs are being covered by other surveys in the U.S. Metric Study.

In April 1970, the Federal Survey team provided the agency representatives with an adequate number of questionnaires for their agencies. The representatives were then responsible for distributing the questionnaires to the respondents within the agencies and also for providing guidance to the respondents in completing the questionnaires.

The liaison representatives were asked to analyze the questionnaire responses and develop an overall response for their agencies. As an aid in preparing the summary, the Federal Survey team sent a suggested outline (copy included on p. 74) to each of the representatives. This outline was the basis on which the final agency summary was to be prepared. The agency responses, along with the completed questionnaires, were to be returned by June 15th to the Federal Government Survey team.

The Federal Survey then collated and analyzed the results and wrote the summaries of the agencies' responses according to the standard format. The time limit precluded the Study from contacting the respondents to straighten out any but the most obvious contradictions and inconsistencies which appeared in the returned questionnaires.

The Survey team then returned the completed agency summaries to the liaison representatives for their comments and approval. Except for minor editorial changes, the summaries which appear in appendix 7 of this report are identical to those approved by the agency representatives. The detailed information therein is analyzed in broader perspective in the following two chapters of this report. Chapter III covers metric impacts on agency internal operations. Chapter IV covers metric effects on the agencies' areas of national responsibility.

III. METRIC IMPACTS ON AGENCY INTERNAL OPERATIONS

Present Situation – The information presented in this part of the survey of Federal Government agencies was obtained from 394 subunit respondents in 50 Federal departments and agencies. (See app. 4 for tabulated responses.) Two hundred and twenty-one (57%) of these offices reported they are already making at least some use of metric measurement units and roughly half that number are involved with metric-based engineering standards. Significant examples of current metric usage reported by Federal agencies are listed in table I. Such occurrences fall in several general categories: (1) in connection with scientific activities using metric, (2) in the interest of international communications and cooperation, (3) attendant to the purchase and use of metric-dimensioned equipment (foreign, or in some cases U.S.-made), and (4) to conform to U.S. industry practices.

Table I

Significant Current Uses of the Metric System in Federal Government Agencies

In connection with scientific research:

Agricultural – *Department of Agriculture*

Health services – *Department of HEW, NIH*

Building, electronic, product evaluation, design and analysis of nuclear reactors and nuclear radiation standards, electrical and electronic metrology – *National Bureau of Standards (NBS)*

Table I – *Continued*

Various laboratory activities – *Treasury Department, Tennessee Valley Authority, Government Printing Office*

Scientific documentation – *Office of Science & Technology, National Science Foundation*

R and D contract assistance – *Small Business Administration*

In activities closely related to science:

Health and mental health services – *Department of HEW, Veterans Administration*

Nuclear reactor engineering – *Maritime Administration*

Nuclear plant planning, procurement, fueling – *Tennessee Valley Authority*

In other engineering activities:

Electronic – *Office of Telecommunications, Department of Commerce; Office of Telecommunications, Department of Transportation; Federal Communications Commission; Office of Telecommunications Policy*

Marine electrical and electronic – *Maritime Administration*

Voluntary engineering standards (most include metric equivalents) – *Engineering Standards Service in NBS*

In science and engineering:

Atomic Energy Commission, NASA (see text)

In connection with international communications, cooperation, trade:

Communications – *U.S. Information Agency*

Overseas contractual services – *State Department, USIA*

Design of buildings to be built in metric countries – *State Department*

Cooperation – *Federal Aviation Administration, U.S. Coast Guard*

Design and construction of intermodal containers and handling equipment – *Maritime Administration*

Formulation of international rules for ships – *Maritime Administration*

Evaluation of foreign ship components – *Maritime Administration*

Trade statistics – *Department of Agriculture*

U.S. tariff schedules – *U.S. Tariff Commission*

Freight tariffs on file – *Federal Maritime Commission*

Table I – *Continued*

International engineering involvement and cooperation – *Tennessee Valley Authority*

Emergency planning regarding maritime shipping – *Office of Emergency Preparedness*

Attendant to use of foreign-made equipment:

Communications, optical – *U.S. Postal Service*

Surveying, topographic mapping, photogrammetric – *Tennessee Valley Authority*

Power generation, transmission, distribution – *Tennessee Valley Authority*

Dictated by U.S. industry practice:

Control of dangerous drugs – *Department of Justice*

Assistance to drug and pharmaceutical businesses – *SBA*

Labor statistics and standards – *Department of Labor*

Regulatory provisions – *Office of Hazardous Materials in Department of Transportation*

With increasing amounts of U.S. manufactured equipment and instruments designed and calibrated in metric – *Tennessee Valley Authority*

Particularly noteworthy is the measurement situation in the Atomic Energy Commission (AEC) and the National Aeronautics and Space Administration (NASA), both of which reported heavily mixed (customary and metric) measurement usage. Nuclear science and most electronic, chemical and nuclear engineering activities are done in metric; mechanical engineering activities in AEC are largely – but not entirely – in customary measurements, while plant engineering is almost exclusively customary. Since all of these activities are intimately mixed in AEC's work, dual measurement usage, with its attendant conversion and interfacing problems and possibilities for error, is the prevailing situation. NASA has a similar measurement environment, with metric widely used in basic research, laboratory analyses, electronics, fluid mechanics, in certain hardware (e.g., optical equipment), and in areas where international programs are important, while such usage is rare in mechanical engineering and design, fabrication, technical and support facilities and plant engineering.

Understandably most of the respondents reporting current metric usage listed one or another advantage thereof in the areas of intercourse with scientific activities, international communications and cooperation, operational improvement through easier calculations and reduced errors, and in some cases cost savings. Several offices in the Department of Agriculture necessarily make extensive use of metric measures in connection with international trade and statistics for international comparisons. The Maritime Administration in the Department of Commerce derives improved capability for evaluating foreign competition from its use of metric. The Department of Labor employs metric units in some of its standards and statistics to conform to certain U.S. industry practices. The U.S. Coast Guard finds its use of the metric system advantageous in regard to review of drawings and specifications, particularly in the field of marine safety. In the Library of Congress, the Prints and Photographs Division measures print sizes and motion picture film gauges in metric, asserting it can thereby "obtain greater measurement accuracy."

Some respondents reported such disadvantages as confusion resulting from dual usage, cost increases (e.g., for maintenance of extra tools), difficulties in obtaining metric-sized replacement parts, and the present preference of most U.S. industry and engineering for the customary system. The only widely-reported disadvantage was employee unfamiliarity with the metric system. It should be noted that these reported difficulties have been imposed by strictly *laissez faire* metrication, and it would not appear practical to eliminate them by an attempt to arbitrarily return to entirely customary usage. Besides, since metric usage has been adopted for good reasons, such an attempt to reverse the trend would impose its own costs, economic or otherwise.

Anticipated Situation in the Absence of Coordinated National Metrication – The Federal agencies were asked to predict probable changes in their measurement language or engineering standards practice, under the assumption that there is no concerted national program to increase use of the metric system in the United States – that our *laissez faire* policy toward measurement usage continues within an increasingly metric world (Assumption I). In this eventuality, 84 of the 394 individual respondents expect to increase their use of metric measurements and/or metric-based engineering standards. Most of these offices mentioned the increasing worldwide and domestic usage as a reason for their expecting to make these changes. Of the 84 respondents, 17 listed improved quality of work or performance, 10 mentioned time and/or cost savings, and 22 cited an expectation that their suppliers may force change on them as further reasons for expecting to increase their own metric usage.

In the Department of the Interior, the Bureau of Commercial Fisheries expects virtually complete metrication of its operations by 1980. The Bonneville Power Administration expects increased use of metric units and standards in view of increasing international trade in the kinds of equipment it purchases. The National Park Service plans to convert its civil engineering activities to metric by 1982 for the resultant time and cost savings. A number of respondents either already have policies for or plan to move in the direction of increased use of metric in their publications, including the Bureau of Reclamation, the Coast and Geodetic Survey, the National Bureau of Standards, all units in the Environmental Health Service (Department of Health, Education and Welfare), and the National Aeronautics and Space Administration. In the Treasury Department, the Bureau of Engraving and Printing anticipates growing metric usage attendant to increasing international interchange of supplies and equipment. The Bureau of Narcotics and

Dangerous Drugs in the Department of Justice is encouraging the drug industry toward total metrication to enable more effective and efficient control of these substances.

The Department of Agriculture observed that the product of one-fourth of U.S. farm acreage goes to markets which are going to be metric, and the units of trade must be provided on the buyer's terms. This is affecting the Marketing Economics Division, the Foreign Development and Trade Division, the Export Marketing Service and the Foreign Agricultural Service. In the Environmental Science Services Administration (now incorporated in the National Oceanic and Atmospheric Administration, NOAA), the National Environmental Satellite Center is pressured between the metrication demands of increased international exchange of satellite data and the preference of those with whom it interfaces domestically for customary measures, and expects slow growth in its use of metric. All (24) surveyed divisions of the National Bureau of Standards expect to increase their use of metric measures and 10 of these their use of SI-based engineering standards, at least in their publications and in many cases also in their research activities. The Office of Ports and Intermodal Systems in the Maritime Administration anticipates increased metrication as a consequence of international agreements. The Office of Telecommunications (Department of Commerce), largely metric already, plans to eliminate one vestige of customary usage by converting miles to meters in frequency management and radio station location records.

Four offices in the National Air Pollution Control Administration foresee their metric usage necessarily increasing due to increasing cooperation with international standards organizations and the demands of national consistency in data reporting – the Bureau of Criteria and Standards expects to be entirely converted to SI in 1973. In the Health Services and Mental Health Administration of HEW, metric usage is expected to grow along with that of the health professions at large. In the Department of Transportation, the Office of Harzardous Materials anticipates a regulatory provision for free choice of units in the activities under its purview, because of pressure from suppliers and increasing worldwide use. The Office of International Aviation Affairs and the Systems Research and Development Service in FAA expect increasing metric usage for the same reasons. In the Atomic Energy Commission four divisions plan to increase employment of SI units and standards, among them: Isotopes Development – "to eliminate the attention required by [use of] the dual system," and Space Nuclear – for "uniformity and consistency, and increased clarity and efficiency of programs." The General Services Administration (GSA) and the Government Printing Office point out that they must, of necessity, follow U.S. suppliers' practice on measurement usage, and the Federal Supply Service and the Standardization Division in GSA expect this to force growing metric usage on their agency. Nine of the 10 NASA Centers anticipate increasing metrication, giving such reasons as "increasing influence of science on engineering," "increased participation in international programs" and "international standardization," and the "advantage of a single system." Three of the Centers expect improved quality of performance of activities, and one (Marshall Space Flight

Center) even expects time or cost savings from this unilateral metrication. In the Veterans Administration, the Office of the Assistant Chief Medical Director for Professional Services expects to expand metric usage in the Administration to reduce the confusion of the dual system. The Engineering Division in the Government Printing Office foresees growing involvement with the SI in connection with purchase of foreign equipment. Two offices in the Library of Congress plan metrication for the advantages of "universal terminology," "accuracy in communications," and "elimination of dual usage."

The third set of data sought under Assumption I pertains to the extent to which the Federal civilian agencies would encounter growing measurement-related problems if the U.S remains officially on the customary system while worldwide metrication proceeds. Of the 394 individual subunit respondents, 168 (43%) replied that they do not plan to increase their use of metric measures unilaterally, and they do anticipate growing measurement-related problems. Such respondents were found in 38 of the 50 surveyed agencies. (An additional 39 respondents who expect to expand their own metric usage, nevertheless anticipate growing problems as a consequence of worldwide metrication.) Difficulties will affect the general areas of: training personnel, dual dimensioning of products, dual inventories, conversions and interfacings between the two measurement systems, and international communications and cooperation. All surveyed agencies which are significantly involved with international relations (including the Department of State, the Department of Agriculture, the United States Information Agency, and the National Aeronautics and Space Administration) foresee growing international communications difficulties. The Department of Agriculture pointed out that the present situation already requires conversions or dual dimensioning of statistics on production and international trade for nearly all commodities. Nearly all exporting countries use or have announced plans to use metric measurements for international trade statistics, as is the case with international organizations. This Department also pointed out that there are problems other than cost and inconvenience: for example, confusion or error as to whether a pesticide spray residue tolerance is given in grains or grams could have serious consequences. The Department of Transportation, including the Federal Aviation Administration, the U.S. Coast Guard and the Bureau of Public Roads, and the United States Tariff Commission expect increasing legal difficulties as a consequence of the rest of the world's adoption of metric. More than half of the respondents in the General Services Administration and most respondents in the Government Printing Office expect problems including increased inventories in this situation. The National Aeronautics and Space Administration expects some failure of equipment and errors in manufacture due to incompatibility or discrete differences resulting from dual dimensioning if it does not extend its own use of metric measurements. (See app. 4 for numbers of respondents, by agency, anticipating growing problems under Assumption I.)

Anticipated Impacts of a Planned National Program to Increase the Use of Metric Measurement Units—The next set of questions in the survey of Federal Government agencies pertained to the assumption of a nationally-planned program to increase the use of metric measurement *units* (language only) in the United States (Assumption II). After a 10-year period of transition, SI measurement units would be used throughout the U.S. in all new and revised documents. Hardware and engineering standards would not be altered for measurement reasons, although the former would be described in metric units and the latter translated into metric terms. (See app. 3, pp. 53 and 61, for detailed definition of Assumption II.)

The agencies were asked what long-term advantages and/or disadvantages such a measurement-language change would hold for their internal operations, and to estimate whether the advantages would outweigh the disadvantages. All of the obvious advantages of general use in the U.S. of a uniform, universal, decimal-based measurement system were listed by respondents to the survey: operational improvement through simplified measurements and calculations and reduced errors, facilitated communication with related scientific activities, improved international communication, facilitated evaluation of products of U.S. and foreign origin, and cost savings. The Department of State, the United States Information Agency, and the Department of Agriculture observed that general employment of the metric system in the U.S. would simplify and facilitate the work of all offices which interact in any way with foreign countries. The Treasury Department feels that providing uniformity with other countries for the exchange of information and data would lead to increased international interchange and trade. The Department of Transportation foresees simplification of regulatory standards from metric usage, and the U.S. Coast Guard anticipates reduced computer (memory) core requirements from the use of metric measures. The Office of Technical and Advanced Planning in the U.S. Postal Service believes the metric system would be easier for the mailing public to comprehend and apply. The U.S. Tariff Commission anticipates improved statistical reporting of imports and facilitated analysis of worldwide trade. The Government Printing Office (GPO) sees easier computations, error reduction and time savings inherent in using the metric system in preparing price scales, pricing of receipt and issues for inventory items, and in platemaking operations. GPO also expects that its computer programming would be more uniform and simplified.

Of the 394 individual respondents, 32 expect they would encounter long-term disadvantages after completion of a planned national program for U.S. adoption of metric measurement units. The most frequently cited disadvantages were operational impairment and operating cost increases, usually attendant to the operation and maintenance of pre-existing equipment and structures designed in the customary system but now to be described in metric units. Operational difficulties would also be encountered as a consequence of the dimensional translation of customary engineering standards into metric measurement units, since in many cases the translation would result in inconvenient to handle dimensional numbers. For this reason several hardware-oriented offices forecast long-term operational impairment and cost increases as a consequence of a measurement-language only change, but gave opposite responses regarding Assumption III (see below);

these include the Office of Design and Construction and the Material Evaluation and Development Laboratory in the General Services Administration, the Letter Mail Equipment Branch in the U.S. Postal Service, and the Office of Construction in the Veterans Administration. The next most noteworthy disadvantage mentioned was lack of comparability of data for previous years. This probably would be faced by a number of agencies which maintain statistical time series. These offices would have to decide on a series-by-series basis whether to convert past data *in toto* or at the time comparisons are made. Use of computers would make the data conversion straightforward.

The Bureau of Land Management in the Department of the Interior raised the problem of the inconsistency between the metric system and the established system of land measurement in the United States, based as it is on the statute mile, which is subdivided into 80 chains. (See app. 6, "Legal Problems", pp. 93, 94.) However, the Bureau observed that our customary land measures could be expressed in metric units, since all resurveys result in fractions of chains and fractions of acres, and these are carried only to the nearest one-hundredth (.01) of a chain or acre.[1] The Bureau stated that, "Providing no attempt is made to change all past records, no problems are anticipated if future work were to be based on the metric system."

Of the total 394 respondents, 231 (66% of those replying to the question) expect that, as far as their internal operations are concerned, long-term advantages of a planned national program for U.S. adoption of the metric measurement language would outweigh any long-term disadvantages. Forty-six respondents (13% of those replying) do not think long-term advantages would outweigh disadvantages. The only agencies with pluralities of respondents believing that advantages would not predominate under this Assumption (II) were the U.S. Travel Service in the Department of Commerce and the Federal Trade Commission. The following either stated agency-level views that advantages would predominate or had no individual respondents who did not so think: Department of the Treasury, Department of Justice, Patent Office, Environmental Health Service, Social Security Administration, Office of the Secretary of Transportation, Federal Highway Administration, Federal Railroad Administration, Civil Aeronautics Board, Federal Communications Commission, Interstate Commerce Commission, National Aeronautics and Space Administration (Centers), National Science Foundation, Tennessee Valley Authority, U.S. Information Agency, U.S. Tariff Commission, Veterans Administration (for health services activities other than construction), and Office of Science and Technology (Executive Office of the President).

The Federal agencies were asked to list the problems such a measurement-language change would raise for them, and how they would go about implementing such a move. All offices using measurement would be involved to some degree with training of already on-board personnel. (A number remarked that the greatest disruption caused by conversion would be in the area of employee response to the change and in the need to re-educate personnel.) The Federal Aviation Administration observed that retraining would pose particular difficulties in its Airports Service, involving extra workloads for air traffic controllers and flight personnel and demands on air-ground communications time. The Environmental Data Service (in the Environmental Science Services Administration) would have a special education problem with its cooperative observers, who are drawn from the general public. (The public would of course be informed about the metric system for everyday use.)

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[1] A possibility to be considered would even be retention of the acre as the unit of land area measure, redefining it in terms of metric linear units—i.e., one acre = $4007.5 m^2$. Note that the practical tolerance cited above, 1/100 acre = $40 m^2$. Thus the suggested conversion falls well within the accepted tolerance range.

Other common tasks of implementation would include: revising drawings, data reporting forms and schedules, and technical publications; rewriting standards; preparing conversion tables and omnibus regulatory changes; converting data banks of statistical, historical and design information; revising specifications for equipment and supplies procurement; and amending relevant legislation to incorporate metric units. Particular efforts in the latter regard would be required in the Treasury Department (customs regulations), the Department of the Interior (basic U.S. land survey laws), some offices in the Department of Agriculture, the Food and Drug Administration, the Federal Trade Commission and the U.S. Tariff Commission.[2] The Tariff Commission would also be involved in renegotiation of trade agreements. Several regulatory agencies would have to publish tariff filing rules in metric units.

A problem in the aviation world that would require particular attention and planning if conversion is deemed desirable would be the use of metric units for aircraft altitudes, elevations and heights, and vertical speeds, since virtually all aircraft and countries in the non-Communist world use the English foot and mile for these measurements. (See, however, pp. 34, 35.) The Office of Merchant Marine Safety in the Coast Guard cited special problems in regard to safety, since simple rounding off of metric equivalent dimensions in safety regulations might be incompatible with current engineering practice and known safety factors. The Environmental Data Service observed that certification of weather records in metric from observations taken in customary units would introduce conversion errors in court documents.

As to special tasks of some particular agencies: The National Bureau of Standards would be involved in rewriting U.S. codes based on standard reference materials and base standards used in building codes. The Weather Bureau would have to coordinate its efforts with Federal Aviation Administration requirements. The Atomic Energy Commission would have to revise drawings, convert product and facility specifications, recalibrate instruments, make some changes in handbooks, and translate standards and codes. The National Aeronautics and Space Administration would face similar problems, and observed that procedures would have to be established to "ensure overall management visibility and control" during the transition. During this period close attention would have to be paid to product requirements, to minimize disputes over unsafe or unacceptable products resulting from measurement errors. The Smithsonian Institution also mentioned the need for increased monitoring of employee work to guard against errors during transition. The Tennessee Valley Authority would have to alter a large number of computer programs, and convert survey markers and registers. The U.S. Postal Service would have to change all scales and measuring devices, revise published materials, and translate engineering specifications appearing in plans, contracts and reports. The Service would also have to change laws relating to weight and measurement of mail, and related rates. (See app. 6, pp. 94, 98.) The Office of Emergency Preparedness would have to revise formats for stockpiled materials. The Government Printing Office would need to alter or recalibrate some printing and binding equipment.

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[2] See app. 6 for listing of legal problems at the Federal level attendant to metrication.

Under this Assumption (II) and the following one (III) the agencies were asked to estimate annual dollar impacts of a coordinated national metrication program on their internal operating costs in two time periods: (1) during a typically 10-year transition period, and (2) thereafter, the United States then being predominantly "on" the metric system. (See "Nature of the Survey," pp. 7 and 8, and app. 3, p. 54, for the bases prescribed for cost impact estimates.) It is understandably difficult to make hard cost estimates for a measurement system conversion in the virtual absence of any experience on which to base such estimates, and there is widespread recognition that probably the most significant benefits from the conversion would lie in the realm of intangibles. (A number of respondents provided cost figures but described them as "gross estimates.")

The only significant areas of *incompleteness* in the reported cost/savings figures are in the Department of Housing and Urban Development and the National Aeronautics and Space Administration. In NASA, five of the 10 Centers comprising the agency provided overall cost/savings estimates; the other five submitted partial, but not complete, figures. Several respondents in the latter Centers felt, "It is impossible to derive a meaningful figure."

Three further remarks are pertinent to the reported cost and savings figures: (1) It seems plausible that cost estimates made in such an environment of uncertainty are likely to be on the "safe," i.e., high, side. (2) If metrication is undertaken there would presumably then be incentive to "do the job" as efficiently as possible, and cost-saving approaches not thought of today would doubtless be developed. (3) It is fairly easy to *identify* the various costs attendant to a metric conversion, even to such relative intangibles as time employees will be away from their job for retraining, and to assign some sort of magnitude to these costs, but it appears more difficult to determine a dollar savings estimate for such long-term benefits as "easier calculations," "reduced errors" and "fewer conversions and interfacings." Thus it is plausible that costs are overstated and the dollar value of benefits understated.

With this as background, net totals of Federal civilian agency estimates of costs/savings attendant to a 10-year coordinated national program for the widespread adoption of metric measurement units in the United States amount to: $32.1 million annual cost during the transition period,[3] and $4.3

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[3] This is an average annual cost over the 10-year transition.

million permanent annual savings thereafter. (All reported figures are tabulated in app. 5.)

Twenty-one agencies forecast no or insignificant cost impact even during the transition, including the Departments of State and Justice, the Patent Office, the Federal Railroad Administration, the Civil Aeronautics Board, the Federal Maritime Commission, the Federal Trade Commission, the United States Information Agency, the Veterans Administration, and the several Offices within the Executive Office of the President. One, the Food and Drug Administration in the Department of HEW, would even expect (average) annual savings of $100,000 during the transition period (with greater annual savings thereafter).

Nine agencies estimated annual added cost impacts during the transition of $1 million or greater: the Department of Agriculture—$8.1 million, primarily in the Soil Conservation Service (in conservation operations, and watershed planning and improvements), the Agricultural Research Service (data conversion, training, temporary inefficiency), and the Extension Service (adult and youth education); the Atomic Energy Commission—$6.7 million, primarily in the Naval Reactors Division and the Division of Reactor Development and Technology (one AEC Division expects substantial savings during the transition period); the U.S. Postal Service—$3.8 million, mostly in the Building Design Division (architectural engineering and design activities), the Letter Mail Equipment Branch (developmental activities), and for the adaptation or replacement of scales; the U.S. Coast Guard—$3.4 million, in the Offices of Operations and of Engineering; the Department of the Interior—$2.1 million, primarily in the Geological Survey, (the Bonneville Power Administration expects costs and savings to balance out over the 10-year transition); the Federal Aviation Administration—$1.7 million, mostly in the Systems Research and Development Service (primarily due to dual dimensioning); the Federal Highway Administration—$1 million, in the Bureau of Public Roads (training and printed matter); the General Services Administration—$1 million, mainly in the Property Management and Disposal Service (inventory, accounting, inspection and purchasing), the Federal Supply Service (specifications and cataloging), the Standardization Division, and the Office of Design and Construction; and the Tennessee Valley Authority—$1 million, mainly in the Office of Power (engineering, operations, maintenance and training), the Office of Engineering Design and Construction, the Office of Agricultural and Chemical Development, and the Maps and Surveys Branch (cadastral, geodetic, topographic, hydrographic, and construction activities).

Other agencies which would expect substantial annual added costs during the transition period include the National Aeronautics and Space Administration—$711,000 (incomplete figure); the Environmental Science Services Administration (now part of National Oceanic and Atmospheric Administration)—$570,000; the U.S. Traffic Commission—$375,000; the Health Services and Mental Health Administration (in HEW)—$347,000; the National Bureau of Standards—$289,000; the Department of Housing and Urban Development—$251,000 (incomplete figure); and the Government Printing Office—$231,000.

Significant annual cost impacts for the Federal civilian agencies in the post-transition period of a measurement-language-only change were estimated as follows: the Department of Agriculture—$3 million savings, mostly in the Agricultural Research Service; the National Aeronautics and Space Administration—$445,000 savings (incomplete figure); the U.S. Postal Service—$250,000 added costs, in the Letter Mail Equipment Branch (development costs); the Food and Drug Administration—$200,000 savings; the Tennessee Valley Authority—$200,000 savings, mostly in the Office of Power (in engineering activities), the Office of Engineering Design and Construction and the Maps and Surveys Branch; the U.S. Tariff Commission—$187,000 added costs (attributable to statistical analyses, investigations and research); the Small Business Administration—$156,000 savings; the U.S. Coast Guard—$132,000 added costs, in the Office of Engineering (mainly for conversion of specs, aids to navigation activities, and training); and the Atomic Energy Commission—$132,000 added costs, savings in the Divisions of Space Nuclear Systems and Isotopes Development falling short of the expected costs in the Naval Reactors Division.

Anticipated Impacts of a Planned National Program to Increase the Use of Metric Measurements Units and Engineering Standards—Under the assumption of a 10-year coordinated national program to increase the use of *metric measurement units and metric engineering standards* (Assumption III), the Federal civilian agencies were asked the same set of questions as under Assumption II above. (See app. 3, pp. 54 and 62 for detailed definition of the Assumption.) In a gross sense, responses under Assumption III paralleled those under Assumption II. The measurement-language change in and of itself would have more impact on most activities than the revision of engineering standards to a rational metric base by itself (which is the *added* factor in Assumption III). Of the 394 subunit respondents, at least 18 percent are entirely uninvolved with engineering standards in their work activities, although they use measurements. (These respondents all answered "don't know" or left blank the questions under Assumption III.)

All of the advantages listed under Assumption II (adoption of metric measurement units only) were also listed for metrication under Assumption III, since the latter includes adoption of metric measurement units. Additional advantages deriving from the adjustment of engineering standards to a rational metric base would include: facilitated international promotion of U.S. standards, reduction of dual standards in international agreements, greatly facilitated relations of the production community to the scientific community, and the possibility of adoption of a more realistic system of nominal sizes and subdivisions thereof. The Bonneville Power Administration in the Department of the Interior and the Tennessee Valley Authority are representative of hardware-using agencies which foresee significant advantages from metrication including engineering standards in the potential for increased harmonization of standards internationally, permitting greater interchangeability of materials, parts and equipment. International comparability of articles, which would improve somewhat with the adoption of metric measurement units according to the U.S. Tariff Commission, would be enhanced even more by eventual harmonization of standards on a metric base.

As under Assumption II, the primary disadvantages listed were operational impairment and cost increases related to the operation and maintenance of equipment and structures designed to customary dimensions and engineering standards. These problems would be somewhat more serious in this case, since manufacturers would eventually begin switching to the production of equipment and parts designed to the revised, metric-based standards, and the maintenance of replacement parts for older, customary-engineered equipment might become somewhat more difficult and costly.

In this context, six respondents who feel that long-term advantages of metrication of *measurement units* would outweigh any disadvantages, hold the opposite view with regard to metrication to include engineering standards. They are: Facilities Management in the Internal Revenue Service, State and Private Forestry in the Department of Agriculture, the Weather Bureau in ESSA, the Bureau of Abatement and Control in the Environmental Health Service (Department of HEW), the Office of Automated Data Management Services in the General Services Administration, and the Lewis Research Center of NASA. On the other hand, five respondents hold just the opposite split of views, believing that metrication of units only would be disadvantageous, on balance, and metrication including revision of engineering standards advantageous. These are: Administration in the Forest Service (Department of Agriculture), the Kansas City Division of Bendix Corporation (AEC contractor), the Office of Design and Construction in the General Services Administration, the Letter Mail Equipment Branch in the U.S. Postal Service, and the Office of Construction in the Veterans Administration. The Building Research Division in the National Bureau of Standards does not know whether advantages would predominate under Assumption II, but feels they would under Assumption III. As the Forest Service Office of Administration put it, "Metrication in units would not take care of the real problem. The real problem would be solved through metrication of both language and hardware." (Obviously at *some* point in future time, whether in 20, 30, or 40 years, all equipment will have been replaced for reasons of wearout or obsolescence—40 years is probably an excessive upper bound, in view of the pace of technological change today—and there would then be no compatibility problem. The question is just how much difficulty would be experienced during the 20- to 40-year period.)

All told, 207 of the 394 respondents (60% of those answering the question) expect that long-term advantages would predominate with metrication under Assumption III, and 47 (14% of those answering) think they would not. (As mentioned above, a number of respondents did not answer questions under this Assumption since they are in no way involved with engineering standards in their work.) As under Assumption II, the only agencies with pluralities of respondents holding that long-term advantages would not predominate under this Assumption are the U.S. Travel Service and the Federal Trade Commission. Three agencies have greater pluralities of responding units which expect advantages to predominate under Assumption III than with metrication of measurement units only: the National Bureau of Standards, the U.S. Postal Service, and the Atomic Energy Commission. Of the 18 agencies with no negative responses as to the predominance of advantages under Assumption II, 15 hold the same view with regard to Assumption III. The exceptions are the Environmental Health Service (Department of HEW), NASA, and the Treasury Department (each of which had one respondent holding the contrary opinion under Assumption III). The Patent Office observed that, even though the advantages are intangible, the opportunity to increase compatibility and standardization on the international level would be significant. In spite of the particular difficulties and efforts that would be encountered in the hardware-involving, operational activities of the Atomic Energy Commission and NASA, most reporting groups in both of these agencies feel that, at least in non-fiscal terms, advantages of metrication would predominate in the long run. Some respondents in these two organizations even foresee eventual fiscal dividends. The general view in AEC and NASA regarding Assumption II versus Assumption III seems to be that, in the long term there would be more gained from a metric conversion that includes revision of engineering standards as well as units. The Veterans Administration feels that "in both health facilities construction and health services operations there would be advantages in the improvement of international communications and in the promotion of U.S. standards. We believe that the advantages of adopting the metric measurement units and engineering standards outweigh any disadvantages, and would be worth the cost as far as our internal operations in the health area are concerned." The Tennessee Valley Authority stated that "advantages of the changeover to the metric system would far outweigh the disadvantages."

The problems of a purely measurement nature attendant to metrication under Assumption III would be the same as those under the previous Assumption. Additional difficulties raised by the eventual revision of engineering standards would include: physical adjustments in building construction, space layout and procurement functions; equipment maintenance and servicing (as discussed above under disadvantages); and acquisition of some additional tools. The AEC observed that these problems would require careful training and supervision of craftsmen, and could lead to errors of interpretation. Several subdivisions in AEC believe they would have to make substantial investments in purchasing new or modifying existing equipment and instruments, and some dual inventories would have to be carried. The Commission feels it unlikely that the conversion of codes and standards to an SI base could be accomplished without specific subsidization by the government, "since the country is already in some difficulties in keeping codes in step with modern materials and processes."

The Federal Power Commission (FPC) stated that the revision of engineering standards would affect its responsibility in studying the safety and adequacy of licensed hydroelectric projects, since this activity involves safety codes covering electrical, structural and hydroelectric design criteria and employing customary measurement terms. However, "the difficulty of performing engineering analysis under two sets of standards would be essentially one of familiarizing staff with metric engineering methods." In the General Services Administration, in addition to the implementing activities mentioned under Assumption II, the Quality Control Division and the Material Evaluation and Development Laboratory would be involved in reissuing many specifications and standards. NASA would face hardware-type changes similar to those in the AEC. The U.S. Postal Service would have to revise engineering specifications for its equipment, and the Government Printing Office (GPO) mentioned conversion or duplication of some of its shop equipment. In the area of legal problems, GPO cited changes in contractual documents concerning machinery and equipment, including warranties. (See app. 6 for listing of legal problems.)

All of the general comments made earlier about difficulties of estimating the cost impact of metrication apply equally to the figures reported under Assumption III. For most agencies which expect significant costs attendant to the *measurement-language* change, estimates of transition costs run somewhat higher for metrication including revision of engineering standards. (Set against this increased cost is the very difficult to evaluate benefit that, having been revised in the light of up-to-date technological knowledge, our engineering standards would be, in the aggregate, better at the end of the transition than they are today.) Net totals of Federal civilian agency cost/savings estimates for a planned, national metrication program including revision of engineering standards to a rational metric base come to: (1) an average $58 million per year added cost during the nominal 10-year transition period and (2) an annual $7.4 million cost savings thereafter.

The 21 agencies which would expect no significant transition cost impact under Assumption II forecast a similar impact under this Assumption. The Veterans Administration, which foresaw no net cost impact under the earlier assumption, estimated an average $20,000 annual savings under this assumption. The Food and Drug Administration, which would expect $100,000 annual savings during a measurement-language conversion, estimated $60,000 annual savings if engineering standards are also revised.

The same nine agencies which would expect $1 million or greater annual transition costs under Assumption II comprise that category under this Assumption: The U.S. Coast Guard – $15.2 million, in the Offices of Operations and Engineering; the Atomic Energy Commission – $9.9 million, mostly in the Naval Reactors Division, the Division of Reactor Development and Technology (for retraining and recalibrating), the Mound Laboratory of Monsanto Research Corporation (primarily for production activities), the Nevada Operations Office (engineering, design, construction and maintenance activities), and the Space Nuclear Systems Division (the Division of Isotopes Development expects a $500,000 average annual savings during transition); the Department of Agriculture – $8.7 million, mostly in the Soil Conservation Service, the Agricultural Research Service, and the Extension Service; the Federal Highway Administration – $7 million, in the Bureau of Public Roads (reflecting increased design costs); the U.S. Postal Service – $3.8 million, mostly in the Building Design Division and for the adaptation or replacement of scales; the Department of the Interior – $3.1 million, almost entirely in the Geological Survey (the Bonneville Power Administration again expects costs and savings to balance out over the 10-year transition); the General Services Administration – $2 million (the increase over the Assumption II figure is in the Federal Supply Service, mainly for inventories and specifications); the Federal Aviation Administration – $1.7

million, mainly in the Systems Research and Development Service; and the Tennessee Valley Authority – $1.3 million, the additions being largely in the Office of Power (for revising internal specifications, and operations and maintenance including inventory) and the Office of Engineering Design and Construction.

Other agencies forecasting significant annual transition cost impacts under Assumption III are: the National Aeronautics and Space Administration – $849,000 (incomplete figure); the National Bureau of Standards – $767,000; the Environmental Science Services Administration (now in NOAA) – $730,000; the Health Services and Mental Health Administration – $708,000; the U.S. Tariff Commission – $575,000; the Government Printing Office – $385,000; and the Department of Housing and Urban Development – $253,000 (incomplete estimate).

Significant annual cost impacts expected by the Federal civilian agencies after a 10-year metrication period under Assumption III are as follows: the Federal Highway Administration – $5 million savings, in the Bureau of Public Roads (from decreased design costs); the Department of Agriculture – $3 million savings, largely in the Agricultural Research Service; the U.S. Coast Guard – $2.2 million added costs, in the Office of Engineering (mainly for "custom manufacture of parts to engineering systems"); the Atomic Energy Commission – $458,000 savings (incomplete figure), savings in the Divisions of Space Nuclear Systems and Isotopes Development, and the Sandia Labs exceeding expected added costs in the Naval Reactors Division; the Health Services and Mental Health Administration – $322,000 savings; the Veterans Administration – $240,000 savings, in the Office of Construction; the Food and Drug Administration – $220,000 savings; the U.S. Tariff Commission – $166,000 added costs, largely for investigations and statistical analyses; the Small Business Administration – $156,000 savings; and the Government Printing Office – $137,000 savings.

What Action Should Be Taken – The final pair of questions in this Survey asked whether the respondents favored concerted action to bring about metrication in the United States, under each of the Assumptions, II and III. The agencies were also requested to provide an overall viewpoint on these questions in their agency summaries (see "Nature of the Survey," p. 8). Of the 50 agencies surveyed, 39 either expressed an overall view, or had a majority of respondents, in favor of metrication under both Assumptions. (See app. 4.) Three agencies had pluralities of respondents in favor of a U.S. metrication effort: the Federal Maritime Commission, the General Services Administration and the Government Printing Office. The Federal Maritime Commission observed that it is uninvolved with engineering standards, and none of its respondents expressed an opinion on metrication under Assumption III. The National Institutes of Health (in HEW) submitted a bifurcated view – one respondent in favor and one opposed – not resolved at the agency level. In one agency, the Social Security Administration in HEW, a majority of the five respondents oppose U.S. metrication (although none of the five foresees any cost impacts, none expects any disadvantages, and only one anticipates any problems during a transition). The remaining six agencies stated that they are little affected by measurement usage: the Social and Rehabilitation Service in HEW, the Civil Aeronautics Board, the Federal Trade Commission, the Interstate Commerce Commission, and the Council of Economic Advisors and the Office of Management and Budget in the Executive Office of the President.

Six agencies, although endorsing U.S. metrication under either plan, stated an explicit preference for "going all the way" and bringing engineering standards into line with the metric measurement units. These included the Department of Agriculture, the Veterans Administration, the Federal Communications Commission, the Patent Office and the National Science Foundation. The Office of Telecommunications Policy (Executive Office of the President) "believes that it is impossible to adopt metric units without adopting metric-based engineering standards in the field of electronics." Several individual respondents in other agencies oppose metrication under Assumption II but favor it under Assumption III, including: the Office of Design and Construction in the General Services Administration and the Letter Mail Equipment Branch in the U.S. Postal Service. The Kansas City Division of Bendix Corporation (AEC contractor) believes that change to metric measurement units without a corresponding change of standards would prove confusing. The Bonneville Power Administration stated that "metrication in both measurements and standards should proceed together."

A total of 32 individual respondents answered "no" to a U.S. metrication effort under one or both of the Assumptions. As mentioned above, three of these do not favor adoption of metric measurement units alone, although they endorse the more comprehensive change in which engineering standards are also revised. It is worth noting that 15 of the other 29 respondents opposed to metrication provided no indication in their entire questionnaire as to why they oppose U.S. metrication with regard to their internal operations. Twelve of these 15 estimated no impact on their internal operating costs *during a transition period,* one estimated \$500, and one – \$800 annual cost. The Disbursing Office in the Government Printing Office, which stated that its mission is "the collection and disbursement of all monies . . .," estimated \$8,000 annual costs, due to "greater inefficiency."

The following are in the category of subunits opposed to metrication and forecasting no cost impact: the Commodity Exchange Authority in the Department of Agriculture stated that its role is regulatory, it is indifferent to the measurement units used, it foresees no costs, no problems for itself, and some advantages, although "ignorance can be more easily offered as an excuse for failing to observe regulations, particularly during the initial stages of the transition period." In the National Communicable Disease Center of the Health Services and Mental Health Administration: the Kansas City Laboratory already "uses metric in all lab work," would have to make "no changes," and observed that, "any changeover of engineering standards should be gradual over 10 years;" the Computer Systems Branch reported "no foreseeable appreciable effect of a coordinated national program." In the Social Security Administration: Printing and Records Management in the Division of Operating Facilities stated "all equipment is replaced within 10 years due to obsolescence;" and the Management Services Branch observed "the metric system is not applicable to these operations." The Bureau of Financial Analysis in the Federal Maritime Commission is concerned with "financial information relating to domestic offshore carriers." Two respondents in the Small Business Administration stated that measurements are "not related to [their] internal operations." In the U.S. Postal Service, Law Enforcement Science and Technology would have to do "practically nothing to change over," and would have "easier engineering calculations." Evidently these respondents, though they would not be affected negatively by U.S. metrication, would on the other hand derive no tangible benefits therefrom.

Eight of the 394 total respondents stated clear-cut reasons for being opposed to U.S. metrication with regard to their internal operations. The National Center for Mental Health Services, Training and Research in the National Institute for Mental Health cited problems in engineering-type activities, adaptation of people including craftsmen and supply clerks, and conversion of records. Five of these eight respondents are involved with the construction, operation and/or maintenance of physical structures: the Buildings and Grounds Department of the U.S. Public Health Service Hospital, Staten Island; the Office of Housing Management in the Department of Housing and Urban Development; the Buildings Management Department of the Smithsonian Institution; the Utilities Design Division in the U.S. Postal Service; and Plant Planning in the Government Printing Office. The Office of Engineering Services in the National Institutes of Health would have problems of dual tooling, replacement parts for equipment, and training. The Burlington Plant of the Atomic Energy Commission would have problems typical of any high-technology manufacturing operation, such as conversion or replacement of scales and gauges, adaptation of fabrication machinery, and retraining of skilled craftsmen.

All told, on an individual respondent basis, 258 of the 394 Federal agency subunits (72% of the 358 answering the question) favor metrication under Assumption II, and 30 (8.4%) are opposed. For metrication including the revision of engineering standards, the corresponding figures are 231 (65% of 354 answering) in favor and 25 (7%) opposed. (The rest of the respondents, in each case, answered "don't know.")

The agencies were asked what would be an appropriate transition period for a coordinated national metrication effort with regard to their internal operations. A consensus of the respondents endorsed a 10-year transition (167 of 231 who expressed an opinion on this question). Of the 54 favoring a shorter period, some are offices already significantly using metric, while others could convert more efficiently over a shorter number of years (for example, offices maintaining statistical time series). Of the 10 subunits advocating a 15- to 25-year transition, several are special cases involving long-life equipment such as buildings or ships, while three (1.3% of those replying to the question) feel "it would take that long to familiarize the populace with the metric system." (Other respondents suggested that a transition period longer than 10 years probably would prove unsatisfactory, since it would encourage delay in making changes.) It appears that all reasonable variants of an "optimum" transition period can be accommodated in a *coordinated* 10-

year program of metrication. The country would not be 100 percent metric at the end of such a period, but could be substantially so.

The agencies submitted the following suggestions regarding implementation of a metrication program in the nation at large:

(1) widespread publicity of the advantages of metric usage and a well-planned program of education and training, including revision of instructional media at all levels;
(2) a joint government-industry-academic-technical society group to conduct detailed studies on implementation;
(3) adoption of a clear, positive U.S. policy, including a unified target date, with specific phases or stages delineated and scheduled – said policy to be achieved by a consensus among government, industry and labor;
(4) preparing as far as possible the paper basis for transition to metric system usage before commencing actual changes;
(5) required use of metric early on for Government publications, regulations and programs, and Federal procurement in metric as and where feasible;
(6) use of dual terminology in Government laws and codes where appropriate;
(7) requiring dual dimensioning on commercial products;
(8) legislation making use of metric units and standards by government and industry mandatory.

The provision of tax incentives or other means of financial assistance was suggested, particularly with regard to small businesses, although it seems clear that in general a subsidized program probably would be less efficient and more costly to the nation as a whole than would a metrication program that relies on the pressures of the market place.

The Council of Economic Advisors submitted several noteworthy suggestions pertaining to implementation of metrication: (1) Although considerable weight in a metrication decision should be given to the opinion of industry, since it should be best informed about immediate benefits and costs, the appropriate role of government is to coordinate conversion if this path is taken. (2) The government also has a role in the decision to convert where those who would benefit (e.g., consumers) are less vocal than others likely to incur larger costs. (3) Additionally, the government should help determine the rate of discount of future benefits from metrication – important since short run costs will undoubtedly appear large relative to expected benefits, but the latter accrue indefinitely in the future (also, industry may be inclined to discount future benefits at a higher rate than the society would deem appropriate). (4) Most weight "should probably be given to the resulting increase in foreign trade," and in this regard, "the volume of trade, not the balance of payments, should be used as a measure of the impact."

Thus, although there would be some problems and significant costs involved, the survey found strong support in the Federal civilian agencies for concerted national action to increase the use of metric measurement units and SI-based engineering standards in the United States. There is a solid expectation in the Federal civilian establishment that long-term advantages of such a move would clearly outweigh any possible disadvantages. A wide consensus regards 10 years as a reasonable time frame for transition to be substantially completed. Although estimates of dollar costs and savings which the effort would impose on Federal agency internal operations are subject to some uncertainty, it is believed that a good indication of their expected magnitude has been obtained.

IV. METRIC EFFECTS ON AREAS OF NATIONAL RESPONSIBILITY

To summarize Federal agency views as to the effects of growing worldwide metric usage on their areas of national responsibility is, in a sense, to assess the effects on the entire nation, since there is no significant activity in the nation which is not in some way an area of Federal responsibility. Nevertheless certain salient facts have emerged from this part of the survey of Federal Government Agencies. Current metric usage in these areas understandably ranges from zero to 100 percent. Impact of the present level of metric usage on these areas of activity varies from *negligible*[1] to *moderate*, except for two fields (shipbuilding and highway safety) which have already experienced *substantial* to *severe* impact. Of the 57 agency inputs to this portion of the Survey, 26 reported some trend of increasing metric system usage in their particular area of national responsibility. With no concerted national metrication effort, 12 of these respondents foresee little or no effect in their area of national responsibility, and 21 expect increasing disadvantages, costs and/or problems, ranging up to *substantial* or *serious* in the areas of air transportation, shipbuilding, highway safety and small business. Twenty-eight of these 57 respondents stated that U.S. adoption of metric usage would have a positive impact on their area of responsibility and/or improve their effectiveness or ability to perform their assigned missions. Three stated that their effectiveness would be impaired during the conversion period. In all, 31 of these agency inputs favor some sort of metrication action, most endorsing a nationally coordinated program to convert the U.S. to the metric system. One respondent[2] opposes any metrication efforts.

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[1] See "Classification of Intensities of Impact," app. 3, p. 79.

[2] Federal Aviation Administration with regard to Aviation Safety.

Detailed discussions of responses regarding the individual areas of national responsibility follow.

A. ENERGY

Department of the Interior
Atomic Energy Commission
Federal Power Commission
Tennessee Valley Authority

Metric usage is currently found in less than one-quarter of potential applications in the energy field. Some metrication is occurring in the natural gas industry (U.S. standard pipe has for some years carried dual dimensions), in the nuclear power industry, and in general because of increasing contact with foreign manufacturers and suppliers and the fact that some domestic manufacturers are beginning to produce to metric dimensions. The Bonneville Power Administration (Department of the Interior) reports that field maintenance personnel are becoming increasingly familiar with the metric system due to the gradually increasing use of metric supplies and parts. The American Society for Testing and Materials is now incorporating SI units in all revisions of its standards. These agencies foresee, in the absence of concerted national action toward metrication, slow and disorderly transfer leading to increased and prolonged disruption of activities.

None of these agencies see metrication as impairing its effectiveness in carrying out its mission over the long run; most of them expect improvement from the inherent simplicity of computations and of recording technical information and measurements, and improved cooperation and communication with suppliers, scientists and engineers abroad. They perceive a trend already toward international harmonization of engineering standards on the part of the Institute of Electrical and Electronic Engineers and other U.S. standards bodies.

The Department of the Interior feels that with a concerted national program of metrication, initial disadvantages in the energy field would be offset by the accumulation of long-term benefits. The Federal Power Commission cited the particularly heavy burden on equipment specification, design, construction and maintenance activities. FPC also pointed out that smaller utilities and municipal power companies might be hard pressed for staff to convert drawings, maps and other data, although schedules for reporting data could incorporate duplicate columns for the two measurement systems during transition. The Atomic Energy Commission suggested that the impacts that would be felt by the nuclear industry would be largely reflected from the efforts of other (contributing) industries. The optimum period for conversion in the power industry would have to be determined in relation to equipment wearout and replacement.

Four of five responding agencies in the Interior Department strongly believe there should be a concerted U.S. program of metrication. The Federal Power Commission urged that research efforts in the field be encouraged to utilize metric engineering practices to increase familiarity with them. The

Tennessee Valley Authority feels the U.S. should move toward adoption of metric engineering standards with the participation of the professional and trade associations.

B. FOOD AND FIBER

Department of the Interior
  Bureau of Commercial Fisheries
Department of Agriculture

In aspects of food and fiber production reported on by these two Departments, current metric usage ranges from zero to three-quarters of potential applications. International trade in these commodities is stimulating greater metric usage. Also, employment of metric measures is growing in the food research community, and several scientific journals now require that all measurements be presented in SI units.

In the absence of concerted U.S. metrication, the Bureau of Commercial Fisheries (BCF) feels that the evolutionary change will nevertheless be advantageous due to the standardization of measurements. The Department of Agriculture expects little, if any, change in its area of cognizance, and consequently little impact on its ability to perform its mission.

With a nationally coordinated program of metrication, BCF expects improvement of its effectiveness, but sees many practical difficulties in the industry in the conversion or replacement of existing equipment, and thinks a longer than 10-year period desirable. The Bureau plays a significant role in the development of international food standards (CODEX ALIMENTARIUS), and this would be greatly facilitated by uniform U.S. metric usage. The Department of Agriculture expects that impacts of coordinated metrication on its ability to perform its mission in the food and fiber area probably would be *negligible*.

BCF suggested that all Federal agency publications require that data be expressed in SI units with parenthetical expression of customary equivalents optional. The Department of Agriculture suggested that a possible indicator of the impact of metrication on the food and fiber industry would be prices of farm supplies.

C. COMMUNICATIONS

Department of Commerce
  Office of Telecommunications
Federal Communications Commission
United States Postal Service
Office of Telecommunications Policy

In the telecommunications area about three-quarters of measurement applications already use metric. The common electrical units are metric-based, while physical dimensions and standards are in customary units, although devices having electrical effects (e.g., tuning elements) are usually described in metric. Many of the energy measurements and standards are in both metric and customary terms, though metric terms predominate. Flow rate and velocity are often found in both terms. Thus the telecommunications industry and its personnel are largely bi-lingual.

A definite trend toward increased metric usage is observed in this industry. There is a growing preference for metric units in measuring distances (such as transmitter locations and elevations and antenna heights) and describing performance of communication equipment. However, since equipment hardware is largely customary-dimensioned, much effort would be required to standardize on a metric base, and the major impact would be felt by U.S. equipment manufacturers. On the other hand, little change would be required in the use of telecommunication equipment.

The Office of Telecommunications Policy noted that the trend has been that costs of products and services in this industry have decreased as new ways to perform old functions have been developed. Thus, cost impacts of metrication may appear not as a cost increase, but as a slower rate of decline. Metrication may make foreign markets more receptive to U.S. electronic products, although it is noted that many other factors such as reciprocal trade agreements and import-export limitations also affect international trade. However, any major improvements in electronic standards commonality among nations, with particular emphasis on U.S. participation, would have strong foreign market implications. The Office of Telecommunications sees overall costs and benefits of metrication closely tied to achieving greater commonality of hardware.

With regard to the optimum period for transition of the telecommunications industry, mixed views were expressed. Some respondents in the Office of Telecommunications feel a 10-year span would be satisfactory. The Office of Telecommunications Policy (OTP) thinks that, in view of the 10- to 15-year time frame for development of some technical standards and the 10- to 20-year depreciable life spans of many in-place facilities, a 20-year period for transition is more realistic.

The Office of Telecommunications and OTP both feel that U.S. metrication would improve their effectiveness in the telecommunications area, while the FCC feels the conversion would have *negligible* impact on its effectiveness since metric usage is almost universal in its work already.

The Federal Communications Commission desires a gradual changeover to metric usage in the U.S. The Office of Telecommunications urged an analysis of the economic impact of converting all equipment and machine specifications, particularly with reference to equipment manufacture. If international standards can be adopted in conjunction with conversion, this should be a national goal. The Office of Telecommunications Policy feels there may be a need for a new or revised telecommunications policy, including international aspects, and changes in FCC rules and regulations stemming from metric system implementation, but none of these can be predicted with certainty at this time.

It appears to OTP that a change to metric usage in electronics is apt to be more successful today than at any other time. Thirty years ago a particular equipment design was expected to last 20 to 30 years. Ten years ago, with the introduction of the transistor, the replacement rate dropped to about 7 years. Today with solid state and integrated circuitry, the replacement rate on electronic design may well be closer to 4 years. Nevertheless, it still may take 20 years to implement metric usage throughout the industry.

In the area of mail communications, less than one-quarter of potential applications uses metric. There is a trend toward increasing metric usage, especially in other countries to which U.S. mail goes, and greater use of metric measurements is being made by countries participating in the development of international mail standards.

In the absence of concerted national action toward metrication, the U.S. Postal Service would probably have to dual dimension some manufacturing drawings and retrain some employees. Impact on the Service's ability to perform its mission would be *negligible*. A planned national program of metric conversion over a 10-year period would require the Postal Service to conduct on-the-job training to familiarize employees with metric measurements and incorporate dual dimensioning on equipment such as parcel post scales. The Postal Service feels that transition over a longer than 10-year period might reduce the total cost impact on its activities.

The overall intensity of impact of a planned national metrication program on mail communications would be *trivial*. The Postal Service is not certain whether metrication would improve or impair its effectiveness, but feels the effect would probably be negligible.

D. TRANSPORTATION

Department of Commerce
    Maritime Administration
Department of Transportation
    United States Coast Guard
    Federal Aviation Administration
    Federal Highway Administration
    Federal Railroad Administration
    Urban Mass Transportation Administration
Civil Aeronautics Board
Federal Maritime Commission
Interstate Commerce Commission
Office of Emergency Preparedness

In general, metric system usage is currently found in less than one-quarter of potential applications in transportation and the impact of such usage ranges from *negligible* to *trivial*. In most areas of transportation there is no inclination to adopt the metric system. The Office of Emergency Preparedness, in its transportation planning function, has recognized a trend toward a more standardized vocabulary stimulated by the growth of international trade and travel. The Office's participation in NATO planning and in American-British-Canadian standardization groups has influenced use of metric terms within OEP, particularly with regard to maritime shipping. The Office of the Secretary of Transportation reports a growing tendency to require expression of international transportation standards (safety, operating, certification) in dual measurements. This trend is evident in such areas as container standards and certification, and facilitation (document sizes). However, in the absence of concerted U.S. action, there will be little overall increase in metric usage in the field, and little effect other than a requirement for DOT to review existing legislation to insure that evolutionary metrication is not adversely affecting transportation standards. It should be noted that intermodal container use is a transportation activity which will result in increasing hardware interfacing between the U.S. and metric-using countries.

Implementation of a coordinated national program of metrication would also impose on DOT a requirement to maintain the viability of transportation standards. The Interstate Commerce Commission cited the metrication impact on the industry of changes in equipment (scales, speedometers), supplies, and standards (maps, speed limits, load limits). Also an "enormous volume" of tariffs on file with ICC would have to be republished by the industry. Reports and data involving ton-miles and vehicle-miles would have to be revised for historical continuity, in addition to the more routine problems of standardizing sizes and dimensions of supplies and equipment. ICC observed that the primary advantage of a metric conversion – increased efficiency through easier mathematical manipulation – is not easily reduced to a dollars and cents return. In addition, metrication would encourage thoughtful consideration as to the desirability of maintaining or retaining many files and reports of marginal utility.

ICC, OEP and the Office of the Secretary of Transportation each feel that U.S. adoption of the metric system would probably improve their effectiveness with regard to the transportation field. OEP recommended adoption of metric as early as consistent with general social and economic conditions, and expects *moderate* impact on overall transportation activities. The Office of the Secretary of Transportation thinks prolonging transition beyond 10 years would probably increase total conversion costs due to dual usage and maintenance of dual records. The Office recommended that it participate in the development and acceptance of transportation standards in metric units.

Current metric usage in air transportation amounts to less than one-quarter of potential applications. The Civil Aeronautics Board makes some metric conversions of statistics for international exchanges and international transportation pricing analyses. The Federal Aviation Administration reported that some aircraft manufacturers are now developing drawings and specifications in metric units, then translating them to customary. As the U.S. is the world leader in civil aviation, and the non-Communist world air transport system is based largely on customary units, there has been *trivial* impact of increasing world metric usage on air transportation so far. However, the International Civil Aviation Organization (ICAO) currently has a panel considering steps toward "unification of units of measurement in air/ground communications." Since 1964 the situation in world civil aviation has been that there are two tables of dimensional units approved for use by ICAO members, the so-called "ICAO Table," which is entirely metric, and the "Blue (interim) Table," which is identically metric except for the units of measurement of altitudes, elevations, and heights (English feet) and vertical speed (feet per minute). There has been a trend in recent years of more countries adopting the use of the "Blue Table." However, there is also a history in recent ICAO Assemblies of the U.S. being consistently outvoted on issues related to eventual standardization on the "ICAO [metric] Table" of dimensional units. FAA feels that, with no coordinated U.S. metrication, the growing worldwide and domestic use will inevitably result in increased costs for tools and support equipment to handle a dual-mode system.

During the transition period of a planned national metrication program there would be substantial costs to FAA and the aviation community for retooling and new inventories. Unfamiliarity with the metric system would slow the handling of air traffic during the conversion. Major reprogramming of computerized air traffic control systems would be required. FAA feels a 15-year transition period would be more appropriate for the air transport industry. While there would be a period of severe readjustments, in the long term metrication would somewhat improve the effectiveness of both FAA and CAB. It would promote U.S. technology sales abroad and improve interfaces with foreign concerns and countries. FAA feels that, in the long run, conversion is desirable toward standardization of technology and control in worldwide aviation.

Possible numerical indicators of metric conversion impact on air transportation are: U.S. aircraft sales to foreign airlines; inventory levels of FAA, aircraft firms, and airline companies; indirect incremental operating costs of FAA and the airlines; and lengths of flight delays.

In the highway transportation area, current measurement usage includes feet, decimal feet, inches, rods, chains, acres, stations (surveying), and some use of metric (theoretical research, materials testing). Impact of current metric usage is *negligible*. Other than its use in laboratory activities, there is no trend of metrication in highway transportation, and with no concerted national action there will be little future change and *negligible* impact. The Bureau of Public Roads observed, "While there is international exchange of highway technology, the product is not exportable or importable," thus the dual measurement usage involves no hardware interface.

A national program of metrication would have wide effects on highway transportation. Standards and plans would require revision, engineering equipment recalibration; highway distance and speed signs would have to be altered and odometers and speedometers converted, if not recalibrated. The problem here is not technical feasibility, but evaluating costs and benefits, neither of which is simply measured (especially the latter). Metrication would temporarily impair the effectiveness of the Federal Highway Administration (FHWA) during conversion, but would have little or no long-run effect. In view of the worldwide metrication trend, FHWA "supports" U.S. conversion, though is "not actively promoting it."

In railroad transportation there is no significant current metric usage and no noticeable trend in that direction. Implementation of a planned national program of metric conversion would result in increased inventory costs to American railroads during transition, thus a short transition period is preferable. The Federal Railroad Administration feels that U.S. metrication would impair its effectiveness during the transition, but slightly improve it over the long term. The operation of American railroads would not be appreciably affected one way or the other by U.S. conversion to metric.

In the field of urban mass transportation, there is little current metric usage and no trend toward its increase. There are few foreign markets for U.S. transit equipment, and relatively small amounts of purchases from abroad. With no concerted national action there will be little effect from increasing worldwide use of the metric system, although purchase of equipment from foreign countries will become more complicated and expensive.

If there were a planned national program of metrication, the Urban Mass Transportation Administration (UMTA) feels that metrication in the U.S. transit industry would be "tremendously complicated." In view of equipment life expectancies, a 20-year time frame for adoption would impose fewer difficulties and costs. UMTA feels that implementation of such a program would impair its effectiveness, although in the long term it would simplify manufacturing, procurement and dealing with foreign suppliers.

UMTA does not regard the transit industry as a major element in a U.S. decision to "go metric." Since there would be some long-term benefits, conversion to metric standards as systems are retooled or replaced would be attractive to the industry and to UMTA from the standpoint of administration of its programs.

Maritime transportation operations use metric in less than one-quarter of potential applications. About 20 percent of tariffs on file with the Federal Maritime Commission incorporate metric measures. The Maritime Administration (Department of Commerce) observes a clear trend in the rest of the world's merchant marine toward complete metrication. This has already resulted in MARAD's having to maintain some dual records, with increased costs and some disadvantages in verbal and written communications. Without orderly U.S. metrication these problems can only increase.

The Federal Maritime Commission (FMC) feels that a planned metric conversion would have *negligible* impact on its transportation areas of responsibility, and would simplify tariff filings. MARAD thinks metrication would improve its effectiveness by simplifying procedures and reducing errors, and result in long-term cost savings. Five of the nine respondents in MARAD favor coordinated national metrication.

The Maritime Commission suggested a promotional program to bring the advantages of the metric system to the attention of the general public. MARAD thinks U.S. conversion to metric must come eventually, and the sooner begun the less expensive it will be. This agency urged a clear and positive U.S. policy, with specific phases or stages delineated and scheduled.

The U.S. Coast Guard (USCG) reported that in shipbuilding activities within its purview, metric usage is already between one-quarter and three-quarters of potential applications. In some cases this has already had *severe* impact on shipbuilding activities. In many cases dual engineering standards are maintained because of the inconvenience or undesirability of converting the measurements for use in the "other" system. The difficulties of the present situation have already impaired USCG's ability to deal with its responsibilities regarding shipbuilding, and it is felt that unless the U.S. acts now in this regard, the U.S. industry will fall even further out of step with the rest of the world. USCG urged metrication as soon as possible.

E. TRANSPORTATION SAFETY

Department of Transportation
  United States Coast Guard
  Federal Aviation Administration
  Federal Highway Administration
  Federal Railroad Administration
  National Transportation Safety Board
  National Highway Safety Bureau

The metric system is used in less than one-quarter of the work activities in transportation safety reported on by these agencies. In the aviation safety field, FAA notes increasing metric usage in engineering and some research and development areas; most aviation medicine work is done in metric. This degree of metrication has had *negligible* impact on FAA's aviation safety mission, and the effect of evolutionary change is expected to so continue in the absence of a national metrication effort. If there were a concerted national program of metrication, FAA feels its effectiveness in dealing with its aviation safety responsibilities would be impaired in the areas of altimeters, and vertical and air speed indicators. With regard to this particular mission, the Agency desires no action to increase metric usage in the U.S. (although offers no suggestions as to how to halt evolutionary change).

In the boating safety area, the Coast Guard pointed out that the U.S. market for pleasure craft is the world's largest, and other nations follow our lead in this field. Since most boating lines are not standardized, problems of interchangeability are minimal, and evolutionary metrication is having *negligible* impact on the industry and on the Coast Guard's ability to perform its boating safety responsibility. Even a concerted national program of metrication would have little impact. Some regulations and standards would require revision. The Coast Guard suggested adoption of the metric system as *soon* as possible, before new standards based on customary measurements are developed, and to avoid inevitably greater costs of a postponed conversion.

In the highway/automobile safety area, there is increasing awareness of metric dimensions and standards due to the growing share (now about 5%) of foreign (mostly metric) vehicles in the U.S. automobile population. The National Highway Safety Bureau observed that this trend has had *substantial* impact on highway safety because of (1) major problems in dual dimensioning of safety-related engineering drawings and specifications, and (2) metric-dimensioned hand tool problems in the repair and service industry. (A philosophy of the Bureau is that any development that makes automobiles easier or more convenient to service thereby improves highway safety.) The Bureau stated that in the absence of orderly U.S. metrication, serious problems in compatibility of design and test specifications and servicing tools will continue. On the other hand, the National Transportation Safety Board expects no effect on auto safety or on NTSB's activities from the evolutionary measurement change.

Safety-related benefits of metrication in the automobile industry would be significant. Uniform specifications could then be used for all vehicles in setting performance requirements and compliance limits. Thus, U.S. adoption of the metric system would improve NHSB's effectiveness. However, major difficulties and changeover pains would add to Government and industry workload during the transition, with *substantial* impact on the Bureau's ability to perform its mission. National Transportation Safety Board would be involved with revisions of manuals, data, plans and specifications, generally "all measurements in transportation systems," and expects some impairment of effectiveness during transition. NHSB remarked that metrication would assist foreign automakers in penetrating the U.S. market, probably more so than with most other consumer products since service and repair considerations can significantly influence auto buying attitudes.

The National Highway Safety Bureau observed that the influence of the automobile permeates the American social, economic and political structure, and that metrication in this area would bring major benefits in product and service standardization. However, the potentially enormous impact of even "small" changes (such as changing roadsigns to indicate metric distances) necessitates thorough advance consideration of economic and other impacts. A carefully planned national program would be required for a smooth U.S. metric conversion. The Bureau believes that, ultimately, metric standardization benefits would be worth the effort.

The metric system is not now used in the railway safety field, and spontaneous metrication is unlikely in the absence of Federal Government action. The Federal Railroad Administration sees a planned metrication program as imposing some additional workload during transition, but improving its effectiveness regarding transportation safety in the long run. FRA "would like to see increasing metric usage within its railroad safety area of responsibility."

F. SCIENCE AND TECHNOLOGY, INCLUDING THE NATIONAL MEASUREMENT SYSTEM

- Department of Commerce
    - Environmental Science Services Administration (ESSA)
    - National Bureau of Standards (NBS)
- National Science Foundation (NSF)
- Office of Science and Technology (OST) (Executive Office of the President

Although the metric system (specifically the International System of Units, SI) is the universal measurement language of basic science, its current application in applied science areas varies considerably. Medical and earth sciences are largely metric. (Geophysics, oceanography and meteorology have strong European roots, thus an early tradition of metric usage.) In academic science and military technology, use of metric measures ranges between one-quarter and three-quarters of potential applications, as is true of information systems, although in this field devices are increasingly standardized and metric usage is increasingly common. In the environmental sciences, applied biology (agriculture, fisheries, forestry), energy, and water resources, the metric system is used in less than one-quarter of potential applications. Gradual metrication is occurring in engineering research and development, but there has been little change in measurement usage in engineering design. The metric system is now widely taught and used in schools and colleges.

With no systematic effort toward U.S. metrication, there would be little effect or impact on most science areas. The evolutionary growth of metric usage, fostering prolonged employment of dual measurements, would cause increasing complications in applied biology, water resources, energy studies and information systems. Engineers would probably face increasing need for dual scales on measuring instruments and conversion of handbooks. The situation in early science education could become chaotic.

Metrication under a nationally planned program would engender some transition problems in space research, civil aviation, national security activities, water resources (e.g., possible conversion of land records) and applied biology. OST states that scientific aspects of national security would not suffer, but insignificant advantages would be gained in this area—although difficulties are inherent in all current dual system usage. OST feels that work in information systems and military technology would definitely benefit "in view of the current trend toward universality of equipment." U.S. metrication would be "easy and advantageous from the standpoint of education—it would simplify arithmetic, delay the introduction of fractions, and generally facilitate much learning for children." The conversion would, of course, greatly benefit international technical cooperation.

OST, NSF and ESSA each foresee some slight impairment of effectiveness during transition, with long-run advantages from the shift, since science, engineering and education would be more easily coordinated. (OST does feel adoption of metric usage would impair its effectiveness in energy studies.) Impact on these agencies and their areas of national responsibility would range from *negligible* to *trivial*. Probably resistance to change would be the greatest problem; costs of conversion in science and technology should be relatively small. As ESSA put it, since a single measurement system clearly would be advantageous for U.S. technology in the long-run, a nationally planned program of metrication would appear to have advantage over the present slow evolutionary conversion with its extended necessity for dual measurement usage.

OST favors U.S. metrication for most science and technology areas under its cognizance. OST's military technology specialist urged that the U.S. "press forward with all due haste in those areas where metrication is feasible." The assistant for national security affairs believes the nation should move toward metrication since it is "inevitable." NSF favors positive action to convert to metric, and ESSA favors a nationally coordinated program.

Possible numerical indicators of the impact of metrication on these areas would be: figures on exports of science-related commodities (e.g., computer tapes), and incidence of use of customary and SI units in technical literature.

The National Bureau of Standards is responsible for maintaining the integrity and consistency of the physical measurement system or systems for the nation, and supporting their effective application throughout science, industry and commerce. With the ever increasing impact of science and technology on all aspects of life in the United States, the present dual measurement usage poses a growing necessity for conversions and interfacing between the two systems. Adoption of metric usage, in addition to facilitating communication between scientists and the engineering-commercial world, would reduce the number of standards required. By eliminating the present need to maintain and support dual measurement systems, metrication would improve NBS's effectiveness in performing its mission with regard to the national measurement system.

G. EDUCATION

Department of Health, Education and Welfare
    Office of Education

Current metric system usage in U.S. educational activities is less than one-quarter of totality. No trend toward increased metrication is observed, and the present usage has had *negligible* impact. In the absence of a national metrication effort, the increasing worldwide and domestic employment of metric will probably have little or no effect on education.

A nationally planned program for adoption of metric might result in minor cost benefits in educational activities. The Office of Education (OE) feels that most of the real benefits would probably come in international communications and standards activities. The Office suggests that it might be difficult to operate a successful metrication program over a longer than 10-year period, since there might be a tendency to delay conversion.

OE feels that U.S. adoption of SI would improve its effectiveness with regard to its mission, by eliminating the necessity to teach and use two measurement systems. There would be difficulties during the transition period when extensive programs of population-wide instruction would be necessary.

The Office of Education favors U.S. metrication for the advantages of a common, worldwide measurement system and data base. It noted that such a conversion would not cause changes which would affect the processes of instruction.

H. HEALTH

Department of Health, Education and Welfare
    Health Services and Mental Health Administration (HSMHA)
Veterans Administration (VA)

Over the past 20 years the health *science* community in the U.S. has converted completely to metric measurement units, and the health *professions* are now using the metric system almost exclusively. The pharmaceutical industry is almost totally metric-based. The conversion to metric usage in the health field took place gradually, and apparently had *negligible* impact on U.S. health activities and on HSMHA's ability to perform its mission. The Veterans Administration observed that further evolutionary metrication is unlikely, since this would involve the more costly adoption of metric engineering standards. In other words, the only remaining area of largely customary measurement usage in the health field is in the engineering standards for design and maintenance of equipment.

Evolutionary measurement change has already brought about improved communication of clinical and health science data. A nationally planned program of U.S. metric conversion would hasten this trend, facilitating measurement and calculation, increasing international cooperation, and eliminating present problems of equipment incompatibility due to differing standards. HSMHA feels that adoption of the metric system would probably improve its effectiveness, since technicians and aides would then already be familiar with metric when entering employment and not have to work with dual systems. Also, the general public would probably better understand dosages of pharmaceuticals. The principal impacts of conversion in the health field would be the initial training of personnel and the conversion or replacement of instruments and equipment. Both HSMHA and VA recommended a nationally planned program for U.S. metrication.

I. LABOR AFFAIRS

Department of Labor

Current metric usage in labor affairs in the U.S. is between zero and one-quarter of potential applications. Some use of metric measurements and engineering standards is found in the area of occupational health and safety, including use by the regulatory agencies in the field. Worldwide and domestic metrication has had *negligible* effect on labor affairs, and no present trend of increased use is observed in this field. There have been some slight disruptions in certain statistics, such as industrial prices, due to changes in specifications.

A nationally planned program of metrication would incur minor conversion costs in the labor statistical area. The Bureau of Labor Statistics expects advantages of the conversion would outweigh disadvantages by the end of the transition period, especially in manpower areas in which there is considerable international work. International activities in trade analysis and statistical exchanges would be facilitated. The transition effort itself would involve training and education programs, such as those conducted by the Manpower Administration, and the Bureau of Apprenticeship and Training observed that concerted action should include a "planned step-by-step program . . . starting with the school systems."

Both of the Department of Labor respondents favor a nationally coordinated program of metrication.

J. TRADE PRACTICES

Federal Trade Commission

The metric system is currently used in less than one-quarter of the nation's domestic trade activities. Evolutionary metric usage has had *negligible* impact on this field. In the absence of Federal Government action toward metrication, this situation will remain essentially unchanged. Imported products originating in "metric" countries will simply continue to bear required expressions of customary weights and measures.

The primary effect of a planned, national program of metric adoption in the Federal Trade Commission's area of responsibility would be the revision of product labeling to show quantities and measurements in metric units. The package industry might have to do some retooling (e.g., depending on the bottle size standards selected to replace pints, quarts). The FTC is unable to estimate whether or not U.S. metrication would improve its effectiveness with regard to the nation's trade practices.

K. SMALL BUSINESSES

Small Business Administration

Present use of the metric system by small businesses is less than one-quarter of possible applications. Although research and development companies employ metric in some of their activities, they tend to use customary units and standards in their contracting. Worldwide metrication has so far had *negligible* to *trivial* impact on the nation's small businesses. The bulk of products of small business firms are consumed by either government or domestic firms—with customary units and standards predominant. Only those small businesses serving foreign markets have been affected.

Continued evolutionary adoption of the metric system without a coordinated national program might have serious consequences for small businesses. In the absence of any Federal assistance, small businesses would tend to lag behind government and larger industries in their spontaneous metrication, and might be put at a competitive disadvantage. The shift would help a limited number of small manufacturers sell abroad, but this advantage could be offset by substantial to severe costs of transition for small manufacturing firms. Metrication could also mean more competition from abroad for small tool and machine manufacturers without an offsetting increase in exports, hindered as they are by high production costs.

The Small Business Administration (SBA) suggested that with a nationally coordinated metrication effort, a program of Federal assistance to small businesses would be helpful. One respondent in SBA thinks the shortest possible transition period would be cheapest in conversion costs. Another feels that a span of conversion of 10 to 20 years would impose a more moderate impact on these industries.

Worldwide and domestic metrication so far has had *negligible* impact on SBA's ability to perform its mission, and it is unclear what future effect increasing metric usage would have in this regard. In the event of a coordinated program of national metrication, respondents in SBA recommend programs of assistance for the Nation's small businesses, in addition to teaching of the metric system throughout the educational system. Indices of foreign exports by small U.S. producers might be used as a numerical indicator of the impact of metrication on small businesses.

L. CONSUMER AFFAIRS

Department of Agriculture
Department of Commerce
General Services Administration
President's Committee on Consumer Interests

Metric units are currently used in less than one-quarter of all measurements within the consumer affairs sphere. Impact of growing metric usage in this area has been *trivial* to *moderate*. The consumer seems to be increasingly aware of the metric system and to accept its use. Imported packaged products are generally labeled in customary units of weight or volume, although many show dual dimensions. Some foreign manufactured furniture and other products are beginning to appear on the U.S. market with dimensions stated only in metric units.

If there is no coordinated action for orderly U.S. metrication, the evolutionary trend will probably continue to be accepted by the consumer, although increasing confusion is likely. It should be recognized that the impact of this trend on the consumer products area is potentially very large. U.S. international trade in these commodities may suffer if the U.S. remains non-metric. Already the Package Proliferation programs of the Department of Commerce (intended to minimize the diversity of sizes in which products are packaged) are put at a disadvantage by the need to retain both metric and customary can sizes.

All of these agencies expect that a planned program of U.S. metrication would result in definite advantages for the U.S. consumer. The Department of Agriculture observed that the problem of being an intelligent consumer is becoming increasingly difficult with the proliferation of goods and services. With adoption of metric usage, communication and calculation would be made more efficient and less costly, and there would be less opportunity for deception regarding container sizes and pricing. There are the well-known frustrations of trying to mentally compare prices of products in different package sizes (e.g., weights in pounds and ounces), which calculations are converted to straightforward decimal operations when metric measurements are employed. Persons of low intellectual ability might have the most difficulty learning and adapting to the metric system, but in the long run benefits to them might be relatively greater in view of the simpler arithmetic.

These agencies expect that impact of a national metrication program on their ability to perform their missions in consumer affairs would be *negligible* to *trivial*, although any consequences would be in the direction of improving effectiveness. The Department of Agriculture suggested that actual adoption of metric measurements take place over a relatively short period (e.g., not more than 5 years), but with much time and effort put into the development of sound plans, in addition to consumer familiarization and education, beforehand. The rate of progress in adoption of metric engineering standards and practices would be governed by obsolescence and other economic factors and demand for change as, and after, the metric language comes into general use.

The Office of Product Standards in the Department of Commerce favors implementation of a planned U.S. conversion to the metric system. The Department of Agriculture and the President's Committee on Consumer Interests urged the conducting of Government programs to facilitate popular understanding of the metric system and its advantages. In addition to this and to dealing with confusions and misunderstandings during the transition, provisions would be needed for protecting the equity of parties involved in transactions and for handling a larger than average number of court cases in this connection. Possible numerical indicators of the impact of metrication on consumer affairs would be prices of products to consumers, and marketing costs.

M. ENVIRONMENTAL POLLUTION CONTROL

- Department of the Interior
    - Federal Water Quality Administration
- Department of Agriculture (USDA)
- Department of Commerce
    - Environmental Science Services Administration (ESSA)
- Department of Health, Education and Welfare
    - Environmental Health Service
- Department of Housing and Urban Development
- Department of Transportation
    - Office of Assistant Secretary for Environment and Urban Systems
    - United States Coast Guard (USCG)
    - Federal Aviation Administration
- Atomic Energy Commission (AEC)
- Federal Power Commission
- Tennessee Valley Authority (TVA)

The degree of employment of the metric system in activities related to environmental pollution control varies widely. Scientific research efforts are largely metric (e.g., health physics, biology). Air and water quality engineers use metric measurements in one-quarter to three-quarters of their work. On the other hand, environmental engineers make little use of metric, as do pollution control equipment manufacturers. Metric usage is gradually increasing in most engineering fields (except environmental). Professional journals in the field are increasingly requiring use of SI units in technical papers. Evolving international cooperation and understanding among scientists and engineers is fostering this trend. The Atomic Energy Commission reports a trend toward probable complete metrication of environmental quality activities under its cognizance.

Impact of increasing worldwide and domestic metric usage on these agencies' pollution control activities has been *negligible* to *trivial*, with some cases of *moderate* impact. The Department of Agriculture reported some changes of measuring devices, and some dual usage with attendant conversions; soil surveys are now published in dual measurement language. To meet the needs of scientific users ESSA provides some data in dual units – tide predictions are so published. The U.S. Coast Guard stated that in maritime pollution control, measuring instruments and technical activities have used the metric system for years.

If there is no national effort toward orderly metric conversion, some of these agencies expect little or no effect. However, the Federal Water Quality Administration (Department of the Interior) stated that continued U.S. use of the customary measurement system will increasingly hinder transfer to the U.S. of technology developed in metric countries. The Agriculture Department anticipates growing cost impacts from evolutionary metrication and increasing difficulties for the Department in performing its pollution control mission. The U.S. Coast Guard foresees some increasing inconvenience. The Tennessee Valley Authority anticipates some recalibration costs, but no real difficulties.

Six of these agencies said U.S. adoption of metric usage would improve their effectiveness in the environmental quality field, and three others suggested that metrication would have very little effect on their mission capability. The Federal Power Commission stated that the impact of metrication on pollution control in its area has been *negligible* so far and "would continue to be so unless there were concerted action to increase use of metric engineering standards," – leaving it at that. USDA observed that U.S. metrication would result in greater international use of our soil and water conservation practices, and greater U.S. use of other countries' technology. USDA and AEC cited facilitated data processing and calculating activities as expected benefits. ESSA pointed out that after metric conversion, instrument makers would no longer have to produce dual lines of products, and present generally unsatisfactory dual usage would be eliminated. The Environmental Health Service cited possible costs for conversion of existing pollution control equipment and spare parts problems, as well as possible benefits to export sales. The Department of Transportation mentioned the potentiality of improved international cooperation, for example on standards in the ocean pollution and aircraft noise areas. TVA expects reduced likelihood of errors and facilitated reporting and interpretation in scientific articles; TVA's environmental engineers, who do not favor metrication, foresee possible impairment of their work during transition in view of conversion costs for maps and charts and the necessity of dual usage during conversion.

Most of these agencies, in respect to their environmental pollution control responsibilities, favor some form of Federal Government action to increase U.S. use of the metric system. The Department of Agriculture, ESSA, USCG, AEC, and TVA all endorse a nationally planned program of metrication, or otherwise "encouraging early adoption" of the metric system. The Department of the Interior suggested that "Government encourage the efforts of industry to convert," and HUD recommended the Government "encourage increased use of SI." The Environmental Health Service recommended that the Government "encourage metrication of U.S. industrial and engineering standards as they are revised and as new standards are developed," and critically evaluate cost effects of metrication on an industry by industry basis.

USDA, alluding to the costs of dual-system operation during transition, urged conversion "as quickly as possible, after thorough development of plans." On the other hand, the Department of the Interior and the Environmental Health Service, doubtless having the problems of equipment conversion in mind, suggested a transition period of 10 to 20 years. Variances of the optimum transition periods for different kinds of activities would have to be considered in developing a national metrication plan.

N. INTERNATIONAL AFFAIRS AND TRADE

Department of State
    Bureau of Economic Affairs
Department of the Treasury
Department of Agriculture (USDA)
Department of Commerce
    Bureau of International Commerce (BIC)
United States Tariff Commission

In general the metric system is used in less than one-quarter of measurement applications in international affairs and trade, and evolutionary measurement change has had generally little impact on these agencies and their areas of national responsibility. In industrial commodities the U.S. is usually able to provide equipment compatible with metric-based systems where this is a condition of sale, and foreign, metric countries wishing to sell on the U.S. market have usually been able to provide non-metric equipment when necessary. The Department of Agriculture reported that, with the widespread use of dual dimensioning in its international affairs area, between one-quarter and three-quarters of measurement applications are in metric. Use of metric in international trade activities is definitely increasing. More and more statistics for international comparisons and world or regional totals are being published using metric units. Foreign markets and customers are important for U.S. agriculture.

Without a national program for orderly U.S. metrication, USDA expects there will be slowly increasing metric usage in this area with continued confusion, increased conversion errors, more problems in meeting other countries' standards, and increasing difficulties in performing its international affairs mission. The Bureau of International Commerce (Department of Commerce) estimates that the competitive position of the U.S. in world trade will probably suffer if the rest of the world continues to "go metric" while the U.S. makes no national effort to do so. This would result from (1) the decline in markets for non-metric goods, and (2) increased competition of metric producing nations in metric markets. The Bureau of Economic Affairs (Department of State) reported its experience that diversity of units of measure or standards among nations acts as a barrier to trade, while uniformity facilitates it. The Bureau believes that "metrication would tend to advance the economic goals of the U.S. and improve well-being in the world at large by removing a 'trade barrier' and encouraging freer flow of goods and services among nations." Most of our export markets are, or soon will be "on" the metric system, and both the relative and absolute importance of these markets are growing constantly. The Treasury Department observed that U.S. metrication would also facilitate imports, but the increase would not be significant. "Given the vast size of the U.S. market, foreign producers presently make the adjustments in their products necessary to sell them in the U.S. under the English (customary) system." It is a consensus of these respondents that the overall impact on the U.S. balance of payments of a harmonized, worldwide measurement system would, if significant, be favorable. The Bureau of International Commerce does feel that imports of metric capital goods might expand temporarily during the transition period.

USDA, as in its other activities, favors as short a transition period as feasible, to minimize the confusion and problems of dual usage. BIC suggests the optimum period for transition would depend on the average depreciation period of production equipment for exports. Since machine tools would be the export most affected by the change, the optimum time for conversion would appear to lie between 10 and 20 years.

In general these agencies feel that U.S. adoption of metric usage would improve their effectiveness in international affairs and trade. International dealings would be facilitated, and there would be lower costs and fewer errors. USDA believes the Government should initiate action to convert, and lead the country. To facilitate comparisons and bargaining with other countries, "U.S. specific import tariff rates and import quotas (copra, sugar, meat, etc.) should be expressed in metric units."

The effects of metrication on this area would be reflected in the balance of trade accounts. However, in view of the many factors influencing exports and imports, it would be difficult to identify specific consequences of metric conversion. USDA suggested that changes in export statistics on specified commodities and packaging might be partial indicators. (The Department noted there have already been instances where a U.S. product was unacceptable to a foreign country because of its packaging in a non-metric size.)

O. ECONOMIC AFFAIRS: TAXATION

Department of the Treasury

Metric measurements are currently used to a limited extent in the taxation field in the U.S. If there is no U.S. program for metric conversion, increasing worldwide and domestic use of metric measures and standards is likely to have little, if any, effect in this field.

If a nationally planned program of U.S. metrication is adopted, the department would have to adapt the relevant tax laws, regulations and forms.[3] Special attention would be required by specific excise tax rates. In view of the *negligible* impact of evolutionary measurement usage change on taxation, the Treasury respondents see no need for U.S. action on metrication.

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[3] See app. 6

Appendix 1

Public Law 90-472 **An Act** 82 STAT. 693

To authorize the Secretary of Commerce to make a study to determine the advantages and disadvantages of increased use of the metric system in the United States.

Metric system. Study.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of Commerce is hereby authorized to conduct a program of investigation, research, and survey to determine the impact of increasing worldwide use of the metric system on the United States; to appraise the desirability and practicability of increasing the use of metric weights and measures in the United States; to study the feasibility of retaining and promoting by international use of dimensional and other engineering standards based on the customary measurement units of the United States; and to evaluate the costs and benefits of alternative courses of action which may be feasible for the United States.

Investigation and appraisal requirements.

SEC. 2. In carrying out the program described in the first section of this Act, the Secretary, among other things, shall—

(1) investigate and appraise the advantages and disadvantages to the United States in international trade and commerce, and in military and other areas of international relations, of the increased use of an internationally standardized system of weights and measures;

(2) appraise economic and military advantages and disadvantages of the increased use of the metric system in the United States or of the increased use of such system in specific fields and the impact of such increased use upon those affected;

(3) conduct extensive comparative studies of the systems of weights and measures used in educational, engineering, manufacturing, commercial, public, and scientific areas, and the relative advantages and disadvantages, and degree of standardization of each in its respective field;

(4) investigate and appraise the possible practical difficulties which might be encountered in accomplishing the increased use of the metric system of weights and measures generally or in specific fields or areas in the United States;

(5) permit appropriate participation by representatives of United States industry, science, engineering, and labor, and their associations, in the planning and conduct of the program authorized by the first section of this Act, and in the evaluation of the information secured under such program; and

(6) consult and cooperate with other government agencies, Federal, State, and local, and, to the extent practicable, with foreign governments and international organizations.

Results of changes in measurement system.

SEC. 3. In conducting the studies and developing the recommendations required in this Act, the Secretary shall give full consideration to the advantages, disadvantages, and problems associated with possible changes in either the system of measurement units or the related dimensional and engineering standards currently used in the United States, and specifically shall—

(1) investigate the extent to which substantial changes in the size, shape, and design of important industrial products would be necessary to realize the benefits which might result from general use of metric units of measurement in the United States;

(2) investigate the extent to which uniform and accepted engineering standards based on the metric system of measurement units are in use in each of the fields under study and compare the extent to such use and the utility and degree of sophistication of such metric standards with those in use in the United States; and

(3) recommend specific means of meeting the practical difficulties and costs in those areas of the economy where any recommended change in the system of measurement units and related dimensional and engineering standards would raise significant practical difficulties or entail significant costs of conversion.

Report to Congress.

SEC. 4. The Secretary shall submit to the Congress such interim reports as he deems desirable, and within three years after the date of the enactment of this Act, a full and complete report of the findings made under the program authorized by this Act, together with such recommendations as he considers to be appropriate and in the best interests of the United States.

Funds.

SEC. 5. From funds previously appropriated to the Department of Commerce, the Secretary is authorized to utilize such appropriated sums as are necessary, but not to exceed $500,000, to carry out the purposes of this Act for the first year of the program.

Expiration date.

SEC. 6. This Act shall expire thirty days after the submission of the final report pursuant to section 3.

Approved August 9, 1968.

GLOSSARY

1. *Customary System:* the system of measurement units (yard, pound, second, degree Fahrenheit, and units derived from these) most commonly used in the United States. Often referred to as the "English system" or the "U.S. system." Our customary system is derived from, but not identical to, the "Imperial system"; the latter has been used in the United Kingdom and other English-speaking countries, but is being abandoned in favor of the metric system.

2. *Metric System:* the measurement system that commonly uses the meter for length, the kilogram for mass, the second for time, the degree Celsius (same as "Centigrade") for temperature, and units derived from these. This system has evolved over the years and the modernized version today is identified as the "International System of Units," which is abbreviated "SI."

3. *International System of Units (SI)*: popularly known as the modernized metric system, it is the coherent system of units based upon and including the meter (length), kilogram (mass), second (time), kelvin (temperature), ampere (electric current), and candela (luminous intensity), as established by the General Conference on Weights and Measures in 1960, under the Treaty of the Meter. A seventh base unit, the mole (for amount of substance) is being considered as another SI base unit. The radian (plane angle) and the steradian (solid angle) are supplemental units of the system.

4. *Metrication:* any act tending to increase the use of the metric system (SI), whether it be increased use of metric units or of engineering standards that are based on such units.

5. *Planned Metrication:* metrication following a coordinated national plan to bring about the increased use of the metric system in appropriate areas of the economy and at appropriate times. The inherent aim of such a plan would be to change a nation's measurement system and practices from primarily customary to primarily metric.

6. *Cost of Metrication:* that increment of cost, monetary or otherwise, directly attributable to metrication over and above any costs that would have been incurred without metrication.

7. *Benefits of Metrication:* monetary and other advantages accruing as a result of increased use of the metric system.

8. *Measurement Standard:* a device or physical phenomenon that is used to define or determine a characteristic of a thing in terms of a unit of measurement established by authority. Examples are gage blocks, weights, thermometers, and mean solar day.

9. *Engineering Standard:* a practice established by authority or mutual agreement and described in a document to assure dimensional compatibility, quality of product, uniformity of evaluation procedure, or uniformity of engineering language. Examples are documents prescribing screw thread dimensions, chemical composition and mechanical properties

of steel, dress sizes, safety standards for motor vehicles, methods of test for sulphur in oil, and codes for highway signs. Engineering standards are often designated in terms of the level of coordination by which they were established (e.g., company standards, industry standards, national standards).

Appendix 3

FEDERAL GOVERNMENT SURVEY
(INTERNAL OPERATIONS)
U. S. Metric Study
Authorized by
PL 90-472, 9-8-68

INTRODUCTION

Background

Public Law 90-472, requires the Department of Commerce to study "the increasing worldwide use of the metric system" in order to determine what action, if any, should be taken in the United States Government regarding metrication to further "the best interests of the United States". This task has been delegated by the Secretary of Commerce to the National Bureau of Standards.

This Survey of Federal Government agencies is one of the major components of the Study. Its purpose is to determine:

1. Which federal agencies use the metric system* and to what extent.
2. Which federal agencies plan to increase metric usage voluntarily (i.e., without any nationally planned program to increase metric usage).
3. What might federal agencies do to hasten metrication** should there be a nationally planned program to increase metric usage.
4. Which federal agencies would be affected, and to what degree, by changes in metric usage external to the agency.
5. To what extent would such changes (i.e., both #3 and #4) improve or impair agency effectiveness.

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*The measurement system based on the meter as a unit of length, the kilogram as a unit of mass, the second as a unit of time, the degree Celsius as a unit of temperature, and units derived therefrom. The modernized version is known as "The International System of Units"(SI)
**Metrication is defined as any act tending to increase the use of the metric system.

Synopsis of Questionnaire

This Questionnaire is divided into two parts. Part I deals with the present and asks in what ways, if any, the subdivisions of your agency use the metric measurement units and metric engineering standards* for products, containers, components, materials, equipment or processes, etc.

Part II deals with the future and asks you (1) to state what changes in measurement units and engineering standards you would like to see with regard to your subdivision (Section IIA) and (2) to predict the effects on your subdivision that would probably occur under three different assumptions:

Assumption 1	No concerted national program to increase the use of the metric measurement units and/or metric engineering standards in a world of increasing metric usage (Section IIB).
Assumption 2	A nationally planned program to increase the use of SI metric measurement units (language only). After a ten year period of transition, SI metric measurement units will be used throughout the U.S. in all new and revised documents except for describing existing customary hardware, replacement parts therefor, and interfaces therewith. (Section IIC of Questionnaire)

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*Engineering standards differ from measurement units (metric measurement units are listed in the first footnote at bottom of page i). Engineering standards consist of practices established by authority or mutual agreement and described in a document to assure dimensional compatibility, quality of product, uniformity of evaluation procedure, or uniformity of engineering language. Examples are documents describing screw thread dimensions, chemical composition and mechanical properties of steel, method of test for sulphur in oil, and codes for highway signs. Engineering standards may be designated in various classes depending upon the level of coordination by which they were established: such as, company standards, industry standards, national standards, etc. The use of metric measurement units must normally accompany the use of metric engineering standards.

Assumption 3 A nationally planned program to increase the use of metric measurement units and metric engineering standards. Metric engineering standards, as well as metric measurement units, will be used for all new and redesigned products after a ten year period of transition. (Section IIC of Questionnaire)

Section IID asks whether you believe that there should be concerted action to bring about changes toward metrication.

Also worth noting is that in several of the sections you do not have to answer the remaining questions in the section if you answer "No" or "Don't Know" ("DK") to the first question.

Costs are to exclude all added or reduced procurement and contracting costs except "specialized hardware" which is designed to the buyer's specification and is not available off the shelf.

Costs are to be based on 1970 dollars and are to be net (e.g., added expenses minus savings).

Another inquiry, complementary to this, will be aimed at searching out the estimated effects of metrication on large scale national systems (e.g., transportation, communication) and on the ability of federal agencies to fulfill their responsibilities in regard to these systems.

INSTRUCTIONS

This questionnaire is designed to elicit your best estimates. Please submit any available data along with your estimates.

Please feel free to use separate sheets of paper on which to put additional information.

Each department (and independent agency) is asked to submit a consolidated response using information derived from the questionnaires which their constituent subdivisions have completed.

Responses should be returned to the department or agency liaison within thirty days from the date of receipt of this questionnaire.

Please look over the questionnaire carefully before beginning to answer the questions.

U. S. DEPARTMENT OF COMMERCE National Bureau of Standards Form NBS-511 (5-70) METRIC STUDY SURVEY FEDERAL AGENCIES	Questionnaire Number	Bureau of the Budget No. 41570015 Approval Expires June, 1971
Agency Name	Respondent Subdivision	
Date Questionnaire Received	Date Questionnaire Completed	

Please Give a Brief Description of Mission of Your Subdivision

Respondent's Name

PART I (Questions Relating to Existing Measurement Systems.)

1. Are metric measurement units and metric engineering standards used in any of your activities?

   - Metric measurement units ☐ Yes ☐ No ☐ Don't Know (DK)
   - Metric engineering standards* ☐ Yes ☐ No ☐ DK

   If both are No or DK, go to Section IIA. Otherwise, please answer questions below.

2. In which activities are your now using the metric system?

   Metric measurement units:____

   Metric engineering standards:_____________________________________

3. Please check the advantages of your present use of metric instead of customary.

Advantages	Metric Units	Metric Engineering Standards
a. Cost Savings		
b. Operational Improvement		
c. Legal Requirements		
d. International Cooperation		
e. Scientific Activities Use SI		
f. Other (Please specify below)		

---

*Please again note that the use of metric measurement units must normally accompany the use of metric engineering standards.

4. Are there disadvantages to your agency in your present use of equipment, components, processes, etc. described in metric units and/or metric engineering standards?

- Metric measurement units ☐ Yes ☐ No ☐ DK
- Metric engineering standards ☐ Yes ☐ No ☐ DK

If both are No or DK, go to Section IIA. Otherwise, please answer questions below.

a. Please explain the disadvantages of your present use of the metric system.

Disadvantages of Present Use	Metric Units	Metric Engineering Standards
a. Increased Costs		
b. Lack of Familiarization		
c. Legal Requirements		
d. Operational Impairment		
e. Engineering and/or Industry Prefers Customary		
f. Other		

b. Do advantages of your present use of the metric system outweigh the disadvantages?

- Metric measurement units ☐ Yes ☐ No ☐ DK
- Metric engineering standards ☐ Yes ☐ No ☐ DK

COMMENTS:____

PART II (Questions Relating to Future Measurement Systems.)

Section A

1. Are there any changes which your subdivision would like to see made in measurement units and/or engineering standards?

- Metric measurement units ☐ Yes ☐ No ☐ DK
- Metric engineering standards ☐ Yes ☐ No ☐ DK

If both are No or DK, go on to Section IIB. Otherwise, please answer questions below.

2. What changes would your subdivision like to see?

Metric measurement units:____

Metric engineering standards:______________________________________

3. Why would you like to see these changes in your subdivision?

Metric measurement units:____

____

Metric engineering standards:______________________________________

____

4. What problems or obstacles for your subdivision do you see in making these changes?

Metric measurement units:____

____

Metric engineering standards:______________________________________

____

COMMENTS:

SECTION IIB: ASSUMPTION 1

We would now like you to forecast or predict probable changes in measurement units and/or engineering standards for your agency, under the assumption that there is no concerted action to increase the use of the metric system in a world of increasing metric usage.

IIB. Under Assumption 1, please answer the following:

1. Do you anticipate that your agency will make changes toward metrication in measurement units and/or engineering standards?

   - Metric measurement units ☐ Yes ☐ No ☐ DK
   - Metric engineering standards ☐ Yes ☐ No ☐ DK

   If both are No or DK, go directly to Question IIB2. Otherwise, please answer questions below.

   a. Please describe the changes you foresee and the probable date of changes.

Metric Measurement Units	
Date	Change

Metric Engineering Standards	
Date	Change

   b. Please check the reasons why you think these changes will occur.

   ☐ 1. To improve quality or performance
   ☐ 2. Suppliers may force the change
   ☐ 3. Increasing worldwide usage of the metric system
   ☐ 4. Increasing domestic usage of the metric system
   ☐ 5. Time and/or cost savings
   ☐ 6. Other (Please specify)

   ____

   ____

   ____

   c. What percentage change in your subdivision's annual internal costs* (either added costs or savings in 1970 dollars) might result from these changes? Please check the most likely percentage change.

Type of Change	0 - .99%	1.00 - 4.99%	5.00 - 9.99%	10.00% or over
Added Cost				
Savings				

---

*Costs are to exclude all added or reduced procurement and contracting costs except "specialized hardware" which is designed to the buyer's specification and is not available off the shelf.

Costs are to be based on 1970 dollars and are to be net (e.g., added expenses minus savings).

Part II Section B continued

d. Please explain why you expect these cost changes.____________________

____

e. What legal problems (for example, changes in laws or codes) would you anticipate if your agency makes these changes?

____

____

f. If your agency makes changes, what difficulties do you foresee in addition to the costs and the legal problems?

____

____

g. What change in mission capability do you expect from these changes? Percentage change in your subdivision's mission capability.

Plus_____% Minus_____%

h. Please explain why you expect these changes in mission capability.

____

____

i. Would the advantages of such changes in mission capability outweigh the disadvantages?

☐ Yes ☐ No ☐ DK

j. If yes, please explain.______________________________________

____

2. Under this assumption, if you do not anticipate that your agency will make changes in measurement units or engineering standards, please check the problem areas you foresee for your subdivision.

☐ a. Training
☐ b. Dual Dimensioning
☐ c. Waste
☐ d. Increased Inventory
☐ e. International Cooperation
☐ f. Increased Conversion
☐ g. Increased Interfacing
☐ h. Legal (changes in codes or laws, for example)
☐ i. Other (Please specify)

____

3. Should any customary engineering standards which you may now use be retained in your activities?

☐ Yes ☐ No ☐ DK

a. If yes, which ones?______________________________________

____

b. Should any of these standards be promoted for international use?

☐ Yes ☐ No ☐ DK

c. Please explain.____

____

COMMENTS:

SECTION IIC: ASSUMPTIONS 2 AND 3

Within Section IIC, both Assumptions 2 and 3 are considered for each of the ten questions.

Assumption 2 - Metric Measurement Units

Assume a nationally planned program to increase the use of metric measurement units (language only) in the United States. After a ten year period of transition -- July 1, 1972 to July 1, 1982 -- SI metric measurement units will be used throughout the U. S. in all new and revised documents except for describing existing customary hardware, replacement parts therefor, and interfaces therewith. Please assume change in language only; do not assume changes toward metric based engineering standards under the Assumption 2 part of Section IIC.

Assume that these language changes will be made on printed material (e.g., catalogues, deeds, labels) only as it is being revised unless there is a need or advantage to do so earlier.

Assume that industry will use the same period of transition so that by July 1, 1982, all products will be described in SI units.

Assume further that SI will be taught throughout the U. S. school system and that the general public will have gained familiarity with SI.

Assume that all countries except the U. S. and Canada will be metric at the outset of the transition period.

Assume that ample time will be available for planning changes.

Assumption 3 - Metric Engineering Standards

Assume a nationally planned program to increase the use of metric measurement units and metric engineering standards.* Metric engineering standards, as well as metric measurement units, will be used for all new and redesigned products after a ten year period of transition -- July 1, 1972 to July 1, 1982. Implicit in this assumption are the following:

Only new or redesigned parts and products will be changed to comply to engineering standards based on the metric system, unless there are distinct advantages in changing existing items.

During the transition period the government, by and large, will use the optimum mix of metric and customary specifications for satisfactory performance and minimum price on initial purchases of new products and that optimum specifications will proceed at a uniform rate from virtually all customary standards in 1972 to virtually all metric standards in 1982.

Based on an orderly program of metrication, industry will be capable of supplying to the government replacement parts requirements in SI or customary standards until existing customary equipment has completed its useful life.

The level or numbers and types of systems and equipment as of FY 1970, will be constant for the purposes of the study, with metric systems and equipment replacing customary systems and equipment as the latter end their useful lives.

Metrication will not disturb the normal cycle of retirement, or modification of existing systems, equipment, and related software.

Assume that all countries except the U.S. and Canada will be metric at the outset of the transition period.

Assume that ample time will be available for planning changes.

---

*The use of metric measurement units must normally accompany the use of metric engineering standards.

IIC Under these assumptions please answer the following:

1. Would there be any internal savings or added costs for your subdivision in 1970 dollars resulting from either of these two assumptions:

   - Metric units only (Assumption 2) ☐ Yes ☐ No ☐ DK
   - Metric engineering standards (Assumption 3) ☐ Yes ☐ No ☐ DK

   If both are No or DK, go directly to IIC5. Otherwise, please answer questions below.

2. What percentage change in your annual internal savings or added costs (in 1970 dollars) during the transition period (1972-1982) might result from this changeover? Please check the most likely percentage change.

Metric Measurement Units (Assumption 2)				
Type of Change	0 - .99%	1.00 - 4.99%	5.00 - 9.99%	10.00% or over
Added Costs				
Savings				

Metric Engineering Standards (Assumption 3)				
Type of Change	0 - .99%	1.00 - 4.99%	5.00 - 9.99%	10.00% or over
Added Costs				
Savings				

3. What percentage change in your annual internal savings or added costs (in 1970 dollars) during the post transition period (after 1982) might result from this changeover?

Metric Measurement Units (Assumption 2)				
Type of Change	0 - .99%	1.00 - 4.99%	5.00 - 9.99%	10.00% or over
Added Costs				
Savings				

Metric Engineering Standards (Assumption 3)				
Type of Change	0 - .99%	1.00 - 4.99%	5.00 - 9.99%	10.00% or over
Added Costs				
Savings				

4. What is your estimate in dollars for average annual savings or costs for your activities for the following periods?

Metric Measurement Units (Assumption 2)				
ACTIVITIES	Transition Period (1972-1982)		Post Transition Period (after 1982)	
	Savings	Costs	Savings	Costs
1)				
2)				
3)				
4)				
5)				
6)				
COMMENTS:				

Metric Engineering Standards (Assumption 3)				
ACTIVITIES	Transition Period (1972-1982)		Post Transition Period (after 1982)	
	Savings	Costs	Savings	Costs
1)				
2)				
3)				
4)				
5)				
6)				
COMMENTS:				

5. Following the transition period, please check the long term advantages and disadvantages you foresee for your subdivision.

Advantages/Disadvantages	Metric Measurement Units Only	Metric Engineering Standards
a. Cost Increase		
b. Cost Decrease		
c. Operational Improvement		
d. Operational Impairment		
e. Promotion of U.S. Standards Internationally		
f. International Communication Improved		
g. Other (Please specify)		

6. In your opinion, would the advantages of the changeover outweigh the disadvantages?

- Metric measurement units ☐ Yes ☐ No ☐ DK
- Metric engineering standards ☐ Yes ☐ No ☐ DK

Please explain:

Metric measurement units:____________________

Metric engineering standards:____________________

7. What would your agency have to do to implement the changeover?

Metric measurement units:____________________

Metric engineering standards:____________________

8. What legal problems (for example, changes in laws or codes) do you foresee for your agency as a result of the transition?

Metric measurement units:____________________

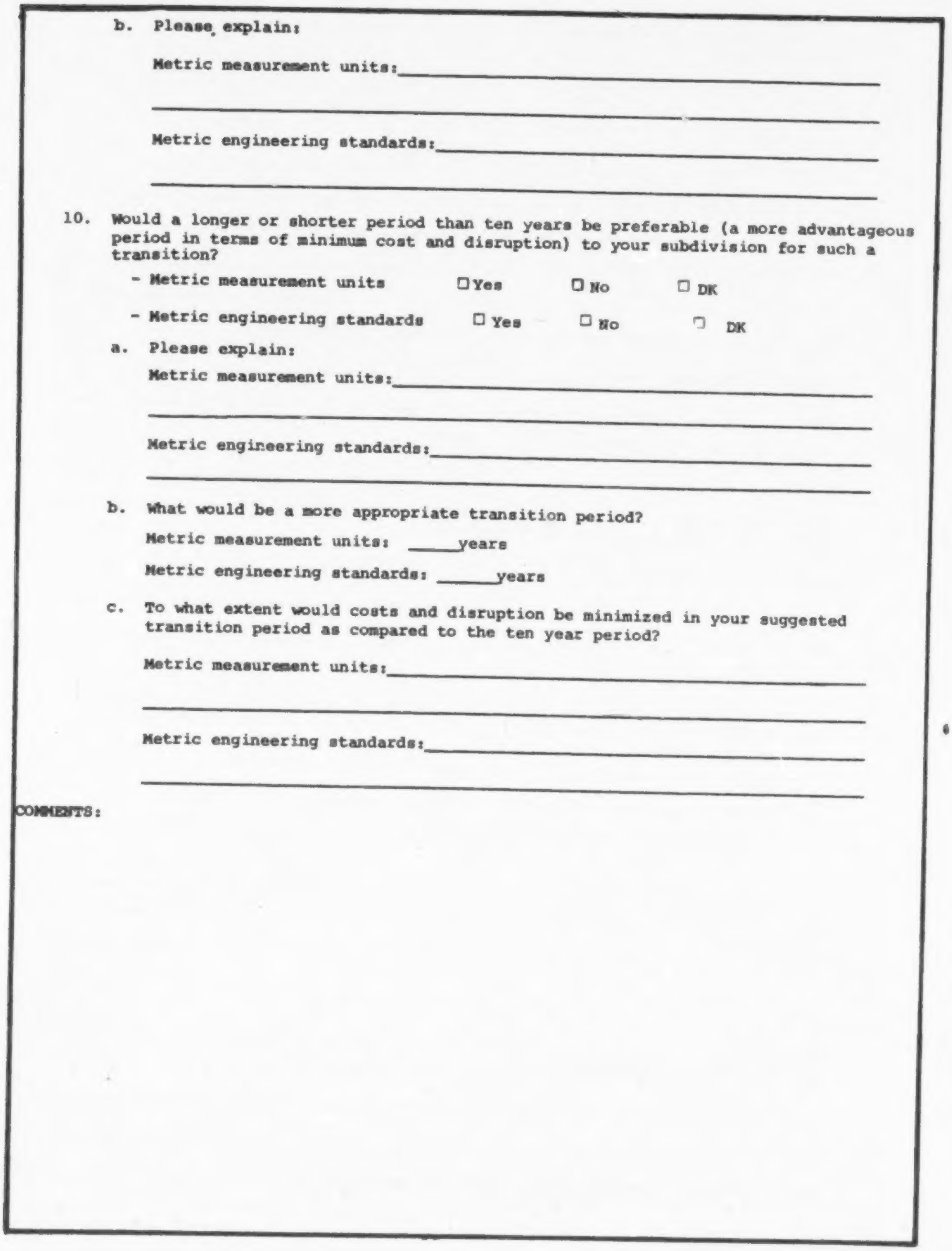
Metric engineering standards:____________________

9. During the assumed ten year transition period, do you foresee any problems for your subdivision in changing completely to the metric system (aside from cost or legal problems)?

- Metric measurement units ☐ Yes ☐ No ☐ DK
- Metric engineering standards ☐ Yes ☐ No ☐ DK

a. If yes, please check the problem areas.

Problem Area	Metric Measurement Units	Metric Engineering Standards
Operational		
Maintenance and Equipment		
Education and Training		
Other (Please specify)		



b. Please explain:

Metric measurement units:______________________________

____

Metric engineering standards:______________________________

____

10. Would a longer or shorter period than ten years be preferable (a more advantageous period in terms of minimum cost and disruption) to your subdivision for such a transition?

- Metric measurement units ☐ Yes ☐ No ☐ DK
- Metric engineering standards ☐ Yes ☐ No ☐ DK

a. Please explain:

Metric measurement units:______________________________

____

Metric engineering standards:______________________________

____

b. What would be a more appropriate transition period?

Metric measurement units: _____years

Metric engineering standards: ______years

c. To what extent would costs and disruption be minimized in your suggested transition period as compared to the ten year period?

Metric measurement units:______________________________

____

Metric engineering standards:______________________________

____

COMMENTS:

PART IID: CONCLUSION

1. Do you think there should be concerted action in the United States to bring about changes toward metrication in measurement units?

   ☐ Yes ☐ No ☐ DK

   a. If yes, what concerted action should be taken?

2. Do you think there should also be concerted action in the United States to bring about changes toward metrication in engineering standards?

   ☐ Yes ☐ No ☐ DK

   a. If yes, what concerted action should be taken?

GENERAL COMMENTS:

Thank you

USCOMM-NBS-DC

"FEDERAL GOVERNMENT SURVEY
Areas of National Responsibility"

This Questionnaire seeks Agency Head estimates of the effect of metrication on:

a. National areas* in which their agencies have responsibility (e.g., transportation, communications, etc.)

b. Ability of federal agencies to perform their missions with respect to those areas of responsibility.

This Questionnaire should be completed and returned to the National Bureau of Standards at the same time as the Federal Government Survey (Internal Operations) Questionnaires.

The "Federal Government Survey: Internal Operations"** Questionnaire and the "Federal Government Survey: Area(s) of National Responsibility" Questionnaire should be reviewed in the preparation of your agency overall statement on the effects of increased worldwide and domestic usage of the metric system.

If more space is needed, please use additional sheets of paper.

---

*By "areas of national responsibility" we mean a "complex" or "system" such as transportation, food and fibre and international affairs. This "system" is for the most part within the private sector of the U. S. economy. In this questionnaire, we seek estimates of the impact of metrication on the ability of the transportation system (for example) to function. We prefer that the opinions expressed be those of the Agency rather than those of the Agency's constituents. The U. S. Metric Study has other Surveys designed to obtain estimates from these constituents.

**The "Federal Survey: Internal Operations" questionnaire, which is being distributed to key personnel within your Agency, is concerned with metrication's effects on your Agency, itself. The two questionnaires complement each other.

Questionnaire for Agency Heads

"FEDERAL GOVERNMENT SURVEY: Areas of National Responsibility"

Agency____

Respondent____________________________________
Name Title

Assisted by:__________________________________
Name Title

____
Name Title

____
Name Title

AREA OF NATIONAL RESPONSIBILITY:

1. To what extent is the metric system used in your area of responsibility (e.g., transportation system) in the United States?

   75 - 100% ☐

   26 - 74% ☐

   0 - 25% ☐

2. Do you discern any trends in metric usage in your area of responsibility?

   ☐ Yes ☐ No ☐ DK

   2a. If yes, please explain.

   ____

   ____

   ____

   ____

3. What has been the impact on your area of responsibility of the increasing worldwide and domestic use of the metric system to the present time? Please estimate the impact according to the scale.*

Negligible	☐	Substantial	☐
Trivial	☐	Severe	☐
Moderate	☐		

---

*See attachment "Classification of Intensities of Impact"

3a. Please explain, as concretely as possible.

____

____

____

____

4. What would be the likely effects on your area of responsibility (advantages, disadvantages, costs, benefits, practical difficulties) of the increasing worldwide and domestic use of the metric system, assuming no action by the federal government.

____

____

____

______________________________.

5. Would adoption of metric measurement units (and/or standards) improve or impair your effectiveness within your area of responsibility in the U. S. (e.g., the transportation system).

Improve ☐

Impair ☐

DK ☐

6. If so, how, and to what extent?

____

____

____

______________________________.

7. What would be the effects on your area of responsibility (advantages, disadvantages, costs, benefits, practical difficulties, etc.) of a nationally planned program to increase the use of the metric system?

The above question should be answered on the basis of two alternative schedules for metrication:

1. Ten year period

____

____

____

____

____.

2. Optimum period (not to exceed 20 years)

____

____

____

____

____.

8. Are there any numerical indicators which could be used as measures of the impact of metrication on your area of responsibility (e.g., balance of payments).

____

____

____

____

____.

9. What is the impact of increasing worldwide and domestic use of the metric system on the ability of your agency to perform its mission with respect to its area of responsibility?

____

____

____

____

9a. Please estimate the impact according to the scale.

Negligible ☐
Trivial ☐
Moderate ☐
Substantial ☐
Severe ☐

10. From the standpoint of your agency, what action, if any, should the United States take with respect to the increasing worldwide and domestic use of the metric system?

____

____

____

____

COMMENTS: ______________________________________

____

____

____

____

FORMAT FOR FINAL REPORT
Federal Government Survey

The Effect of the Increasing Worldwide and Domestic Use of the Metric System on:

The Operations of Selected U. S. Government Agencies, and on The Areas of National Concern (ANR) for which they are responsible.

Part I. A Synthesis of the entire survey

Part II. The Individual Agencies and Departments

Outline for Agency Chapter (using Atomic Energy Commission as an example)

I. Atomic Energy Commission

1. Mission of AEC
    a. general description of mission
    b. aspects of mission likely to be affected by metrication
2. Extent of present usage of Metric System in the AEC
    a. activities in which metric is now used.
        i. measurement units only
        ii. engineering standards and measurement units
    b. advantages and disadvantages of present usage
    c. trends to present

3. Changes which Agency would like to see
   a. changes in measurement units and engineering standards
   b. reasons for wanting changes
   c. obstacles in making changes
4. Anticipated changes toward metrication under the assumption that there is no concerted action to increase the use of the metric system in a world of increasing metric usage (Assumption 1).
   a. anticipated changes in measurement units and engineering standards; dates of change
   b. reasons for such changes
   c. costs or savings resulting from such changes
   d. problems and obstacles in making such changes
   e. effect on mission capability of such changes
   f. problem areas if such changes are not made
   g. would advantages of such changes outweigh disadvantages?
   h. customary engineering standards to be retained and/or promoted for international use under Assumption 1.
5. Anticipated impacts under a nationally planned program to increase use of SI metric measurement units (language only) Assumption 2.
   a. changes in annual internal savings or added costs.
      i. during transition period
      ii. during post transition

b. activities in which these changes will take place

c. long term advantages and disadvantages under Assumption 2

d. will advantages outweigh disadvantages?

e. how agency would implement changeover

f. agency legal problems foreseen as a result of changeover

g. other problems facing agency during the transition.

h. transition period preferred by Agency.

i. intensity of impact on agency*

6. Anticipated impacts under a nationally coordinated program to increase use of metric based engineering standards as well as metric measurement units. (Assumption 3)

   a. changes in annual internal savings or added costs.

      i. during transition period

      ii. during post transition

   b. activities in which these changes in costs will take place

   c. long term advantages and disadvantages under Assumption 3.

   d. will advantages outweigh disadvantages?

---

*See last page for a listing of the criteria used for each of the five classifications for intensity of impact.

  - e. how agency would implement changeover.
  - f. agency legal problems foreseen in agency as a result of changeover
  - g. other problems facing agency during the transition.
  - h. transition period preferred by Agency
  - i. intensity of impact on agency*

7. Agency's opinion on whether there should be coordinated action in the U. S. to bring about changes toward metrication:
   - a. toward metric measurement units,
   - b. toward metric based engineering standards as well as metric measurement units.

B. Impacts of Metrication on Areas of National Responsibility (ANR) of the Atomic Energy Commission (Energy)

1. Extent of metric usage in ANR
   - a. present usage
   - b. trends to present
   - c. present impacts on ANR of increasing usage of metric system
2. Likely future impacts on ANR of the increasing use of the metric system, assuming no nationally coordinated program by the Federal Government.
3. Impact on the ability of Agency to perform its mission with respect to its ANR, assuming no nationally coordinated program to increase use of the metric system.

---

*See last page for a listing of the criteria used for each of the five classifications for intensity of impact.

4. Impacts on Agency's ANR of a nationally coordinated program to increase use of metric during and after the ten year transition period; the optimum transition period.

5. Intensities* of impact on the ANR of a nationally coordinated program to increase use of the metric system.

6. Impacts of adoption of metric system upon Agency's effectiveness in dealing with ANR: under Assumption 2; under Assumption 3. (nationally coordinated programs)

7. Numerical indicators of impact of metrication within ANRs. (e.g., balance of payments)

8. Agency's viewpoint as to what actions the U. S. should take with respect to the increasing use of the metric system.

C. Impacts of Metrication on Areas of National Responsibility of the Atomic Energy Commission (Environmental Pollution Control)

etc.

---

*See last page for a listing of the criteria used for each of the five classifications for intensity of impact.

Classification of Intensities of Impact

1. Negligible
   a. Need only to convert bulk produce quantities from pounds to kilograms, gallons to liters, etc.
   b. Already converted
   c. Need to do nothing - measured size of objects not important

2. Trivial
   a. Need to re-label, double label, or redescribe package goods and products.
   b. Need to make simple adjustments on machines or products to nominal metric sizes.
   c. Need to replace simple measuring devices such as rulers, thermometers.
   d. Need to change dials on scales and guages.
   e. Most problems can be solved by conversion charts.

3. Moderate
   a. Need to replace complex measuring devices.
   b. Need to maintain dual inventories.
   c. Changes in containers necessary.
   d. Parts of tools must be replaced such as rollers and dies.

4. Substantial
   a. Screw cutting and gear cutting machines must be modified.
   b. Major readjustments must be made in machines or products to convert to a metric system.
   c. Extensive changes in engineering drawings must be made.
   d. Stock sizes must be changed.
   e. Decisions must be made on fasteners.
   f. Complex and expensive metric measuring equipment will have to be acquired; less complex equipment will have to be provided at all work stations or machines, etc.

5. Severe
   a. Of such impact as to make change disastrous or inadvisable.
   b. Non-metric practice practically world-wide.

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Appendix 4. Agency Responses Regarding Internal Operations

	Number of respondents	Favors metrication under Assumption II*			Favors metrication under Assumption III*			Currently using metric	Will increase metric usage under Assumption I*	Problems if metric usage not increased under Assum. I**	Advantages outweigh disadvantages? (Assumption II)*			Advantages outweigh disadvantages? (Assumption III)*			< 10-year transition	10-year transition	> 10-year transition
		Yes	No	DK	Yes	No	DK				Yes	No	DK	Yes	No	DK			
Department of State	2	2			2			1		2	2			2				2	
Department of the Treasury	8	7		1	7		1	5	3	1	6		2	5	1	2	2	4	
Department of Justice	3	3			3			1	1	2	3			3				3	
Department of the Interior	10	8		1	6		3	10	5	3	8	1	1	7	1	2	2	8	
Department of Agriculture	23	18	2	1	12	2	5	11	6	12	19	3	1	17	3	3	4	[1]14	
Department of Commerce:																			
Environmental Science Services Administration	5	3	1	1	2	1	1	5	3	2	4	1		2	2			4	
Maritime Administration	9	5	1	3	4	1	4	3	2	6	5	1	2	5	1	2		5	1
Patent Office	4	4			4			3		4	3		1	3		1		1	
National Bureau of Standards	24	18		4	16		6	24	14	2	15	1	3	16	1	3	3	[2]9	
U.S. Travel Service	1	1					1					1			1			1	
Office of Telecommunications	1	1			1			1	1										
Department of Labor	6	3		1	3		1	2	1	1	1		3	1		3	1	3	
Department of Health, Education and Welfare:																			
Environmental Health Service	13	12		1	12		1	11	7	4	12			11	1		3	5	1
Food and Drug Administration	12	8		2	8		2	9	1	7	9		2	7		4	1	2	

Health Services & Mental Health Administration	[3]49	31	6	7	26	5	13	31	6	24	30	6	8	24	8	14	9	20	
National Institutes of Health	2	1	1		1	1		1		1	1	1		1	1				1
Office of Education	28	12		11	11		12	3	2	9	11	3	8	8	1	12	4	10	
Social Security Administration	5	2	3		2	3				2	1		4	1		4			1
Social & Rehabilitation Service	1			1			1						1			1			
Department of Housing & Urban Development	14	11	1	2	10	1	2	3	3	7	9	2	2	7	2	3	2	4	2
Department of Transportation:																			
Office of Secretary of Transportation	4	3		1	3		1	3	1	3	4			4				1	
U.S. Coast Guard	5	3		1	3		1	5	1	2	3	1	1	3	1	1	1	[4]2	
Federal Aviation Administration	7	4	1	1	4	1	1	2	2	3	4	1	1	3	1	1	1	3	
Federal Highway Administration	1	1			1					1	1			1					
Federal Railroad Administration	2	2			2			1		2	2			2			2		
Atomic Energy Commission	24	14	1	7	14	1	7	24	4	10	15	4	3	16	3	3	1	[5]9	2
Civil Aeronautics Board	1			1			1			1	1			1				1	
Federal Communications Commission	1	1			1			1			1			1					
Federal Maritime Commission	4	2	1	1			4	2			2	1	1	1	1	2		1	
Federal Power Commission	1	1			1					1			1			1			
Federal Trade Commission	1			1			1	1				1			1			1	
General Services Administration	15	7	1	3	7		4	6	2	9	6	4	3	6	4	3	1	8	
Interstate Commerce Commission	1			1			1				1					1			
NASA (Centers)	10	9		1	9		1	10	9	9	7			6	1		2	8	
National Science Foundation	8	6		2	5		3	3		3	2		4	1		5		3	
Small Business Administration	11	6	3	2	4	3	4	2		5	4	2	4	4	2	4	1	6	
Smithsonian Institution	17	11	1	2	11	1	2	12	2	2	8	2	2	7	2	3	3	3	
Tennessee Valley Authority	5	5			5			3		4	5			5			2	3	
U.S. Postal Service	21	14	2	3	14	2	3	5	3	12	10	5	3	11	4	3	3	[6]10	1
U.S. Information Agency	[7]3	2			2			3		1	2			2			1	1	
U.S. Tariff Commission	1	1			1			1		1	1			1				1	
Council of Economic Advisors	1																		
Veterans Administration	3	2	1		2		1	2	1	2	2	1		2		1		2	1
Office of Emergency Preparedness	7	1	1	4	1	1	4	2	1		1	1	5	1	1	5		3	

See footnotes at end of table, p. 82.

Appendix 4. Agency Responses Regarding Internal Operations—Continued

	Number of respondents	Favors metrication under Assumption II*			Favors metrication under Assumption III*			Currently using metric	Will increase metric usage under Assumption I	Problems if metric usage not increased under Assum. I**	Advantages outweigh disadvantages? (Assumption II)*			Advantages outweigh disadvantages? (Assumption III)*			< 10-year transition	10-year transition	> 10-year transition
		Yes	No	DK	Yes	No	DK				Yes	No	DK	Yes	No	DK			
Office of Science and Technology	1	1			1			1			1			1				1	
Office of Telecommunications Policy	1	1			1			1		1									
President's Committee on Consumer Interests	1	1			1								1			1			
Government Printing Office	10	5	3	1	4	2	3	3		5	6	3	1	6	3	1	2	4	1
Library of Congress	7	5		2	4		3	4	2	2	3		3	2		4		4	
Total respondents	394	258	30	70	231	25	98	221	83	168	231	46	71	207	47	93	54	167	10

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* *Assumption 1:* No concerted national program to increase the use of the metric measurement units and/or metric engineering standards in a world of increasing metric usage.

Assumption 2: A nationally planned program to increase the use of SI metric *measurement units* (language only). After a 10-year period of transition, SI metric measurement units will be used throughout the U.S. in all new and revised documents except for describing existing customary hardware, replacement parts therefor, and interfaces therewith.

Assumption 3: A nationally planned program to increase the use of *metric measurement units and metric engineering standards*. Metric engineering standards, as well as metric measurement units, will be used for all new and redesigned products after a 10-year period of transition.

** This figure includes only those respondents who do *not* anticipate that they will increase metric usage under Assumption I. The figure for NASA is a special case, however, because there are some groups at each Center which do not plan on increased usage, but who expect problems.

[1] Under Assumption II, five respondents favor a shorter transition period than 10 years, 13 favor a 10-year transition period, and no respondents favor a transition period longer than 10 years.

[2] Under Assumption II, four respondents favor a shorter transition period than 10 years, eight favor a 10-year transition period, and none favor a transition period longer than 10 years.

[3] A total of 51 questionnaires were submitted by HSMHA; however, there was a set of duplicate responses (from Health Facilities Construction Branch, Headquarters of the Indian Health Service) and one questionnaire (National Clearinghouse for Smoking and Health) was returned untouched.

[4] Under Assumption II, two respondents favor a shorter transition period than 10 years, one favors a 10-year transition period, and none favors a transition period longer than 10 years.

[5] Under Assumption II, one respondent favors a shorter transition period than 10 years, 10 favor a 10-year transition period, and one favors a transition period longer than 10 years.

[6] Under Assumption II, three respondents favor a shorter period than 10 years, nine respondents favor a 10-year transition period, and one respondent favors a longer period.

[7] Five questionnaires were submitted by USIA, however, two were untouched.

Appendix 5

Agency Cost Impacts (Annual)

Reported agency estimates* of annual added costs (+) or savings (−) during a 10-year metric conversion effort and in the post-transition period.

+ ? net cost, amount undetermined	DK don't know
− ? net savings, amount undetermined	( ) incomplete figure

	All dollar costs are in thousands							
	Assumption II				Assumption III			
	Transition		Post-transition		Transition		Post-transition	
	Percent [1]	Dollars [1]	Percent	Dollars	Percent	Dollars	Percent	Dollars
Department of State	±0	0				+99	−?	
Department of the Treasury		+127.5		−40		+141.6		−7
Comptroller of the Currency	+0–1	+20			+0–1	+20		
Bureau of Customs, Management Analysis Division	−0–1	−30	−0–1	−30	−0–1	−30	−0–1	−30
Bureau of Engraving & Printing	+1–5	+50		+15	+1–5	+50		−27
Internal Revenue Service:								
Facilities Management Division		+50		−25		+50		+50
Alcohol, Tobacco and Firearms Division		+37.5	±0–1	Negligible		+51.6	±0–1	Negligible
3 Respondents	±0	0	±0	0	±0	0	±0	0
Department of Justice	−?	Insignificant	−?	Insignificant	−?	Insignificant	−?	Insignificant
Department of the Interior		+2,125		−40		+3,127		−90
National Park Service	+0–1	+125	+0–1	+50	+0–1	+127	+0–1	Negligible
Geological Survey	+1–5	+2,000	±0	0	+1–5	+3,000	±0	0
Bonneville Power Administration	±0	0	−1–5	−90	±0	0	−1–5	−90
7 Respondents	±0	0	±0	0	±0	0	±0	0
Department of Agriculture		+8,086		−2,977		+8,691		−2,977
Forest Service.								
National Forest System	+0–1	Negligible	−0–1		+0–1	Negligible	−0–1	

See footnotes at end of table, p. 91.

Appendix 5. Agency Cost Impacts (Annual)—Continued

	All dollar costs are in thousands							
	Assumption II				Assumption III			
	Transition		Post-transition		Transition		Post-transition	
	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars
Department of Agriculture: Continued								
Research	+0-1	Negligible			+0-1	Negligible		
State & Private Forestry	+1-5	+40	+1-5	+115	+1-5	+40	+1-5	+115
Programs & Legislative Report	+0-1	+0.5	±0	0	+0-1	+0.5	±0	0
Rural Electrification Administration	+0-1	+10	−0-1		+0-1	+15	−0-1	
Soil Conservation Service	+1-5	+4,850	+0-1		+1-5	+4,850	+0-1	
Packers & Stockyards Administration	+0-1	+5	±0	0	+0-1	+5	±0	0
Economic Research Service:								
Economic Statistical Analysis Division	+1-5	+40	−1-5	−20	+1-5	+40	−1-5	−20
Marketing Economics Division	+1-5	+130	−0-1	−10		+230	−0-1	−10
Foreign Development & Trade Division	−1-5	−10	−5-10	−20	−1-5	−10	−5-10	−20
Statistical Reporting Service	+1-5	+56.5	±0	0	+1-5	+56.5	±0	0
Agricultural Research Service	+1-5	+2,000	−1-5	−3,000	+1-5	+2,000	−1-5	−3,000
Cooperative State Research Service	+0-1	Negligible	+0-1	Negligible	+0-1	Negligible	−0-1	Negligible
Extension Service	+1-5	+1,000	−0-1	0	+1-5	+1,500	−0-1	0
Agricultural Stabilization & Conservation Service	+0-1	Slight	−0-1	Slight	+0-1	Slight	−0-1	Slight
Foreign Agricultural Service	−1-5	−10	−10+	−12	−1-5	−10	−10+	−12
Export Marketing Service	−0-1	−26	−0-1	−30	−0-1	−26	−0-1	−30
6 Respondents	±0	0	±0	0	±0	0	±0	0
Department of Commerce:								
Environmental Science Services Administration	+0-1	+570	+0-1	Negligible	+1-5	+730	+0-1	+38
Maritime Administration		+6		−0.3		+7		−0.3

Office of Ship Construction	+0-1	+3	−0-1	−0.3	+0-1	+3	−0-1	−0.3
Office of Ship Operations	+0-1	+1	−0-1	Insignificant	+0-1	+2	−0-1	Insignificant
Office of Administrative Services	+0-1	+2	±0	0	+0-1	+2	±0	0
6 Respondents	±0	0	±0	0	±0	0	±0	0
Patent Office		−0.5		−0.5		−0.5		−0.5
National Bureau of Standards		+289		0		+767		(−1.5)
Applied Radiation Division	+1-5	+75	−0-1	−30	+1-5	+75	−0-1	−30
Building Research Division	+0-1	+20	+0-1	+10	+10+	+400	+0-1	+40
Cryogenics Division	+1-5	+50	±0-1	0	+1-5	+50	±0-1	0
Mechanics Division	+1-5	+20	−1-5	−10	+1-5	+30	−1-5	−12.5
Metallurgy Division	±0	0	±0	0	+1-5	+5	+0-1	+1
Metrology Division	+0-1	+15	±0	0	+1-5	+125	−0-1	0
Nuclear Radiation Division	+0-1	+1	+0-1		+1-5	+5	+1-5	
Office of Standard Reference Materials	+0-1	+6-10	±0	0.	+ [illegible]	+15	±0	0
Office of Weights & Measures	±0	0	±0	0	[illegible]-5	+12	±0	0
Radio Standards Engineering Division	+1-5	+100	+0-1	+30	+1-5	+50	+0-1	
14 Respondents	±0	0	±0	0	±0	0	±0	0
U.S. Travel Service	±0	0	±0	0	±0	0	±0	0
Office of Telecommunication:	+0-1	+2	±0	0	+0-1	+4.5	±0	0
Department of Labor		+8.5		0		+8.5		0
Department of Health, Education & Welfare:								
Environmental Health Service		+67.9		−13.4		+174.9		−31.4
Office of Admin: Div. of Gen. Services	+1-5	+2.4	−0-1	−0.4	+1-5	+2.4	−0-1	−0.4
Envir. Control Admin: Div. Tech. Operations	+0-1	+3.5	−0-1	−1	+0-1	+13.5	−0-1	−1
National Air Pollution Control Administration:								
Bur. Abatement & Control	+1-5	+50	±0	0	+10+	+125	±0	0
Bur. Criteria & Standards	+0-1	+12	−0-1	−12	+0-1	+34	−0-1	−30
9 Respondents	±0	0	±0	0	±0	0	±0	0
Food and Drug Administration		−100		−200		−59.5		−220
Asst. Commissioner for Field Coord	±0	0		0	+0-1	+0.5		
Bur. of Foods, Pesticides, & Product Safety	−0-1	−100	−0-1	−200	−0-1	−60	−0-1	−220
10 Respondents	±0	0	±0	0	±0	0	±0	0

See footnotes at end of table, p. 91.

Appendix 5. Agency Cost Impacts (Annual)—Continued

	All dollar costs are in thousands							
	Assumption II				Assumption III			
	Transition		Post-transition		Transition		Post-transition	
	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars
Department of Health, Education & Welfare—Continued								
Health Services & Mental Health Administration		(+257.4)		(−101.4)		(+618)		(−321.7)
Div. of Emergency Health Services	+1–5	+50	±0	0	+1–5	+75	±0	0
Indian Health Serv., Hlth. Facil. Constr. Br. Hdq.	+0–1	+16	−1–5	−96	+10+	+320	−10+	−320
Constr. & Maint. Br., Alaska	+10+	+11	−10+	−11	+10+	+11	−10+	−11
Office of Environmental Health, Hdqtrs.	+0–1	+100	+0–1		+0–1	+120	+0–1	
Intramural Research Program (NIMH)	+0–1	+4.5	±0	0	+0–1	+5	+0–1	+0.5
Natl. Center for Mental Health Service, Training & Research (NIMH)	+5–10	+36.5	+1–5	+15	+5–10	+47.6	+1–5	+18.2
Nat. Communic. Disease Center, TB Branch	+0–1	+1	+0–1		+0–1	+1	+0–1	
Administrative Service Branch	+0–1	+3.9	±0	0	+0–1	+3.9	±0	0
Regional Medical Programs Service:								
Nutrition Program	+1–5	+15	−1–5	−10	+1–5	+15	−1–5	−10
USPHS Hosp., San Fran. (Nursing)	−0–1	Little	−1–5	−8.4	−0–1	Little	−5–10	−8.4+
USPHS Hosp., St. Island, (Buildings & Grounds)	+10+	+9	+10+	+9	+10+	+9	+10+	+9
(Dietetics)	+1–5	+10.5	±0	0	+1–5	+10.5	±0	0
37 Respondents	±0	0	±0	0	±0	0	±0	0
Ft. Worth Clinical Res. Cntr., NIMH	DK				DK			
National Institutes of Health		+50+		+10+		+50+		+10+
Office of Education		+31.5		−30		+31.5		−30
Bureau of Elementary & Secondary Education	+0–1	+1.5	±0	0	+0–1	+1.5	±0	
Educational Broadcast Facilities Program	+5–10	+30	−5–10	−30	+5–10	+30	−5–10	−30
26 Respondents	±0	0	±0	0	±0	0	±0	0
Social Security Administration		0		0		0		0
Social and Rehabilitation Serv.	±0	0	±0	0	±0	0	±0	0

Department of Housing & Urban Dev.		(+251)		(+105)		(+253)		(+105)
Office of International Affairs	+1–5	+6	−1–5	−5	+1–5	+8	−1–5	−5
Office of Technical & Credit Studies	+0–1	+5	±0	0	+0–1	+5	±0	0
Products Acceptance Branch	+10+	+240		+110	+10+	+240		+110
9 Respondents	±0	0	±0	0	±0	0	±0	0
Office of Housing Management	DK				DK			
Operation Breakthrough	DK				DK			
Department of Transportation:								
Office of Secy. of Transportation	±0	0	±0	0	±0	0	±0	0
U.S. Coast Guard		+3,355		+132.5		+15,220		+2,222
Office of Engineering	+0–1	+355	+0–1	+132.5	+5–10	+2,720	+5–10	+2,222
Office of Operations	+0–1	+3,000	±0	0	+1–5	+12,500	±0	0
3 Respondents	±0	0	±0	0	±0	0	±0	0
Federal Aviation Administration		+1,700		(0)		+1,700		(0)
Systems R&D Service	+10+	+1,500	±0–1		+10+	+1,500	±0–1	
Air Traffic Service	+0–1	+200	±0	0	+0–1	+200	±0	0
5 Respondents	±0	0	±0	0	±0	0	±0	0
Federal Highway Administration	+0–1	+1,000	−0–1	−800	+0–1	+7,000	−0–1	−5,000
Federal Railroad Administration		0		0		0		−50
OHSGT, Engineering R&D Div	±0	0	±0	0	±0	0	−1–5	−50
Bureau of Railroad Safety	±0	0	±0	0	±0	0	±0	0
Atomic Energy Commission		+6,708		+132		+9,883		(−458)
Bendix Corp. (Kansas City Div.)	+1–5	+90	+0–1	+20	+0–1	+60	−0–1	−10
Burlington Plant	+0–1	+10	±0	0	+1–5	+300	±0	0
Division of Construction:								
Engineering Branch	+0–1	+19	±0	0	+0–1	+19	±0	0
Staff Communications Branch	+5–10	+10	+1–5	+2	+5–10	+10	+1–5	+2
Transport Management Branch	±0	0	±0	0	±0	0	±0	0
Dow Chemical Corp. (Rocky Flats Plant)	+0–1	+79	+0–1	+10	+0–1	+318	+0–1	+50
Fallout Studies Branch	±0	0	±0	0	±0	0	±0	0
Gen. Elec. Co. (Pinellas Pen. Pl.)	+1–5	+220	±0	0	+1–5	+260	±0	0
Lawrence Radiation Labs	+0–1	[2] +50–100	±0	0	+0–1	[2] +80–120	±0	0
Los Alamos Scientific Lab	±0	0	±0	0	+1–5	+400	−?	
Mason & Hanger Corp. (Pantex Pl.)	+0–1	+10	±0	0	+1–5	+321	±0	0

See footnotes at end of table, p. 91.

Appendix 5. Agency Cost Impacts (Annual)—Continued

	All dollar costs are in thousands							
	Assumption II				Assumption III			
	Transition		Post-transition		Transition		Post-transition	
	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars
Atomic Energy Commission: Continued								
Monsanto Res. Corp. (Mound Lab.)	+5-10	+300	−0-1	−150	+5-10	+500	−0-1	−150
Naval Reactors Division	+10+	+5,000	+5-10	+1,000	+10+	+6,000	+5-10	+1,500
Nevada Operations Office	+0-1	+250	±0	0	+1-5	+500	±0	0
Production Division	+0-1		−0-1		+0-1		−0-1	
Div. of Isotopes Development	−5-10	−500	−5-10	−500	−5-10	−500	−5-10	−500
Div. of Reactor Dev. & Tech.	+0-1	+1,000	±0	0	+0-1	+1,000	±0	0
Raw Materials Division	±0	0	±0	0	±0	0	±0	0
Sandia Labs	+0-1	+95	−0-1	−100	+0-1	+95	−0-1	−100
Space Nuclear Systems Division	+0-1	+50	−1-5	−150	+1-5	+500	−5-10	−1,250
4 Respondents	±0	0	±0	0	±0	0	±0	0
Civil Aeroanutics Board	±0	0	±0	0	±0	0	±0	0
Federal Communications Commission	±0	0	±0	0	±0	0	±0	0
Federal Maritime Commission	±0	0	±0	0	±0	0	±0	0
Federal Power Commission		+15	±0	0		+15	±0	0
Federal Trade Commission	+0-1	Negligible		0		Negligible		0
General Services Administration		+1,000		0		+2,000		+100
Interstate Commerce Commission	+0-1	+70	−0-1	−5	+0-1	+70	−0-1	−5
National Aeronautics & Space Administration		(+711)		(−445)		(+849)		(−125)
Ames Research Center	±0	0	±0	0	±0	0	±0	0
Flight Research Center		+16				+16		
Goddard Space Flight Center	+0-1			−?	+5-10			+?
Jet Propulsion Lab		+50-500		−1-100		+75-750		−0.5-50
Kennedy Space Center		+110		−?		+110		−?
Design Engineering, Electron. Sys. Div		+10		−100		+10		−100

Launch Vehicle Operations	"negligible"		?		"negligible"		?	
Medium Launch Vehicle Div		+ 100				+ 100		
Langley Research Center:								
Engineering & Tech. Service	+ 1-5		?		+ 1-5		?	
Structural Research Division	"little"				"little"			
Lewis Research Center		+ 100		− 45	?	+ 100 +	?	
Manned Spacecraft Center:								
Flight Operations:								
Advanced Planning Support Off		+ 160				+ 160		
Landing & Recovery Div	"less than future savings"				"less than future savings"			
Mission Planning & Analysis Div		− ?				− ?		
Technical Assistance		+ "millions"				+ "millions"		
Information Systems Div	+ 1-5			− ?	+ 10 +			− ?
Medical Research & Operations Directorate		+ 50		− 250	DK	+ 50 +	DK	
Propulsion & Power Division	+ 5-10		DK		+ 5-10		DK	
Reliability & Quality Assurance Office	+ 33		DK		+ 33		DK	
Space Physics Division: Science & Applications	− 1-5				− 1-5			
Marshall Space Flight Center	+ 10 +			− ?	+ 10 +			− ?
Wallops Station	+ 1-5			–	+ 1-5			–
National Science Foundation		0		0		+ 300		0
Office of National Centers and Facilities	± 0	0	± 0	0	+ 0-1	+ 300	± 0	0
7 Respondents	± 0	0	± 0	0	± 0	0	± 0	
Small Business Administration		+ 155.6		− 155.6		+ 155.6		− 155.6
Office of Business Development	+ 5-10	[3] + 155.6	− 5-10	[3] − 155.6	+ 5-10	[3] + 155.6	− 5-10	[3] − 155.6
10 Respondents	± 0	0	± 0	0	± 0	0	± 0	0
Smithsonian Institution		+ 23.3		(0)		+ 31.1		(0)
Astrophysical Observatory	± 0	0	± 0	0	+ 0-1	+ 0.3	± 0	0
Buildings Management Department	+ 0-1	+ 10	± 0	0	+ 0-1	+ 17.5	± 0	0
Div. of Military History	+ 10 +	+ 0.9-1.5	+ 10 +	+ 0.9 − 1.5	+ 10 +	+ 0.9-1.5	+ 10 +	+ 0.9 − 1.5
Environmental Science	+ 1-5	+ 10	± 0	0	+ 1-5	+ 10	± 0	0
Radiation Biology Department	+ 5-10	+ 2.2	± 0	0	+ 5-10	+ 2.2	± 0	0
12 Respondents	± 0	0	± 0	0	± 0	0	± 0	0
Tennessee Valley Authority	+ 1-5	+ 1,000	− 1-3	− 200	+ 1-5	+ 1,300	− 0-1	− 100
United States Postal Service		+ 3,763.3		+ 249.5		+ 3,763.3		− 125.5
Building Design Div.[4]	+ 10 +	+ 2,250	± 0	0	+ 10 +	+ 2,250	± 0	0

See footnotes at end of table, p. 91.

Appendix 5. Agency Cost Impacts (Annual)—Continued

	All dollar costs are in thousands							
	Assumption II				Assumption III			
	Transition		Post-transition		Transition		Post-transition	
	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars
United States Postal Service—Continued								
Bureau of Research & Engineering:								
Letter Mail Equip. Branch	+5–10	+250	+5–10	+250	+5–10	+250	−1–5	−125
Engineering Support Branch	+0–1	+3.3	−0–1	−0.5	+0–1	+3.3	−0–1	−0.5
Office of Tech. & Adv. Planning	+0–1	Negligible	−0–1	Negligible	+0–1	Negligible	−0–1	Negligible
Bureau of Facilities: Program Management	+1–5	+76	−0–1		+1–5	+76	−0–1	
Adaption or replacement of scales		+1,184				+1,184		
11 Respondents	±0	0	±0	0	±0	0	±0	0
United States Information Agency	"little or no"				"little or no"			
United States Tariff Commission	+5–10	+375	+1–5	+187	+10+	+575	+1–5	+166
Veterans Administration		+100		−40		−20		−240
Office of Construction	+1–5	+100	−0–1	−40	−0–1	−20	−1–5	−240
2 Respondents	±0	0	±0	0	±0	0	±0	0
Council of Economic Advisors	±0	0	±0	0	±0	0	±0	0
Office of Emergency Preparedness		+0.5		0		+0.5		0
Office of Science & Technology	±0	0	±0	0	±0	0	±0	0
Office of Telecom. Policy	+0–1	+1.5	±0	0	+0–1	+1.5	±0	0
President's Comm. on Consumer Interests	±0	0	±0	0	±0	0	±0	0
Government Printing Office		+230.9		−26.4		+385.3		−137.5
Disbursing Office	+0–1	+8	±0	0	+0–1	+8	±0	0
Engineering Division	+1–5	+39.6		+1.5	+10+	+54.6		+0.5
Field Service Division	+0–1	+11	±0	0	+0–1	+11.8	±0	0
Personnel Division	+0–1	+5		0	+0–1	+5		0
Plant Planning Division	+5–10	+29	±0	0	+5–10	+29	±0	0
Purchasing Division	+0–1	+137.7	−0–1	−27.5	+1–5	+275.4	−0–1	−137.7

Typography & Design Division					+1-5	+0.8	+0-1	+0.1
Tests & Tech. Control Service	+0-1	+0.6	−0-1	−0.4	+0-1	+0.7	−0-1	−0.4
2 Respondents	±0	0	±0	0	±0	0	±0	0
Library of Congress		+21.2		(0)		+26.2		(0)
Division for the Blind and Physically Handicapped	+0-1	Insignificant	−0-1		+0-1	+5	−0-1	
Prints & Photo Division	+5-10	+21.2			+5-10	+21.2		
5 Respondents	±0	0	±0	0	±0	0	±0	0

*See Nature of the Survey (p. 7) and Summary of Metric Impacts on Internal Operations (p. 18).

[1] Agencies were asked to give percentage change in annual internal costs, and 1970 dollar figures (see questionnaire, app. 3, pp. 54, 63, 64).

[2] Ten percent of total cost, but transition actually to be spread over 20 years.

[3] Figure derived by Metric Study Group, by applying percentage estimate to agency-supplied 1970 budget figure.

[4] Ten percent of total for comparability; actual transition over 15 years, with most of cost in first ten.

Appendix 6

LEGAL PROBLEMS ATTENDANT TO A NATIONAL METRICATION PROGRAM

PART A

Examples of occurrence of customary measures in the Code of Laws of the United States which might require amendment or adjustment in the event of a national metrication effort.

Title 7 – Agriculture:

7 USCA	301	College-Aid Land Appropriation.
	501	Tobacco statistics: collection and publication (exemption).
	624	Limitations on imports (quotas issued pursuant thereto by Presidential proclamation).
	901	Peanut statistics: collection and publication (exemption).
	1112, 1118	Sugar and liquid sugar quotas.
	1301	Loans, Parity Payments, etc. Definitions.
	1313, 1314b, 1315	Tobacco marketing quotas.
	1330, 1333–1335	Wheat marketing quotas (land area measure).*
	1344	Cotton marketing quotas (land area measure).
	1353	Rice marketing quotas (land area measure).
	1358	Peanut marketing quotas (land area measure).
	1379b	Wheat marketing allocation (land area measure).
	1441 note	Price support levels.
	1446	Price support levels for designated nonbasic agricultural commodities.
	1571	Prohibitions relating to interstate commerce in certain seeds.
	1781, 1782	National Wool Act of 1954: Declaration of policy.

(Note: Other sections employ the term "acreage allotments," but do not specify amounts of acreage. Presumably "acreage" could be measured in other units if so desired.)

Title 15 – Commerce and Trade:

15 USCA	231, 234, 237	Standard barrel (apples, fruits or dry commodities, lime).
	251, 252	Standard baskets.
	257	Standard hampers and baskets.
	1453	Fair Packaging and Labeling Program: Requirements of labeling.
15 USC	1702(a)(2)	HUD Act of 1968 (Interstate Land Sales Full Disclosure).

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*As noted above in the discussion, consideration should be given to the feasibility of retaining the acre as unit of land measure, redefining it in terms of square meters.

Title 16 – Conservation:

16 USCA	5	Rights-of-way through parks or reservations.
	478a, 479	Townsites within national forests, sites for schools and churches (land measure).
	522	Rights-of-way for electrical plants.
	523	Rights-of-way through national forests for power and communications facilities.
	781	Restriction on taking or catching commercial sponges in Gulf or Straits of Florida.
	1002	Watershed protection and flood prevention.

Title 19 – Customs Duties:

19 USCA	1202	Tariff Schedules of the United States (substantial use of length and weight measures).

Title 21 – Food and Drugs:

21 USCA	20	Apples in interstate commerce; standard grades.
	61	Filled milk; definitions.
21 USC	620	Federal Meat Inspection Act.

Title 23 – Highways:

23 USCA	103(d)	Federal-Aid systems: Interstate System.
	127	Vehicle weight and width limitations – Interstate System.
	131	Control of outdoor advertising.
	136	Control of junkyards.
	204	Forest highways.
	205	Forest development roads and trails.

Title 26 – Internal Revenue Code:

26 USCA	4041, 4071, 4073, 4081, 4091	Excise taxes on motor fuels, oils and tires.
	4161, 4173	Excise taxes: sporting goods, photographic film.
	4271	Excise tax on transportation of coal.
	4501, 4511	Excise taxes: sugar, coconut and palm oil.
	4521–4591	Import taxes.
	4701, 4702, 4711	Internal revenue taxes: narcotic drugs, opium.
	4741	Tax on marihuana.
	4811, 4812, 4814	Tax on adulterated butter.
	4831	Tax on filled cheese.
	4851, 4853	Tax on cotton futures.
	5001–5122	Gallonage and occupational taxes on distilled spirits, wines and beer.
	5701, 5707	Tobacco taxes.
	5801, 5811, 5848	Taxes on firearms and firearms dealers.

Title 30 – Mineral Lands and Mining [mostly land area measure]:

30 USCA	27	Tunnel Site Act.
	36, 39	Placer claims, and Surveyors.
	71, 72, 83	Entry of coal lands.
	103, 121, 184	Entry of other mineral lands.
	185	Rights-of-way for pipelines.
	201–206	Leases of coal land.
	207	Coal lands; Royalties, etc.
	208	Permits to take coal for local domestic needs.
	212–214	Leases of phosphate lands.
	223, 227, 229	Oil and gas leases.

Title 30 – Mineral Lands etc. Continued

	241	Oil shale leases.
	251	Alaska oil proviso.
	261, 263	Sodium prospecting permits, leases.
	271, 273	Sulfur prospecting permits, leases.
	281, 283	Potash prospecting permits, leases.
	305	Lease of oil and gas deposits in and under railroads and other rights-of-way.

Title 31 – Money and Finance:

31 USCA	317	Minor coins; weight.
	349	Deviations allowed in adjusting weights of silver coins.
	364	Standard troy pound for regulation of coinage.
	365	Standard weights for mints and assay offices.
	391	Minting and issuance of clad coins; specifications.

Title 33 – Navigation and Navigable Waters:

33 USCA	145–145m	Lights and shapes under International Rules for Navigation at Sea.
	172–180	Lights under inland navigation rules.
	203	Steam vessels approaching, meeting or passing each other.
		Navigation rules for Great Lakes:
	252–254, 256, 258	Rules concerning lights.
	271	Sound signals.
		Navigation rules for Red River of the North and Rivers Emptying into Gulf of Mexico and Tributaries.
	312, 313, 319, 320, 322	Rules concerning lights.
	445	New York harbor: equipment and marking of boats or scows.

Title 39 – The Postal Service

39 USC	3682	Size and weight limits for non-letter mail.

Title 40 – Public Buildings, Property and Works:

40 USCA	345	Spacing of public buildings.

Title 42 – The Public Health and Welfare:

42 USCA	1463(a)	Financial assistance for urban renewal projects in areas involving colleges, universities or hospitals.
	1958a	Saline water demonstration plants.

Title 43 – Public Lands [mostly land area measure]:

43 USCA	161, 204–206, 212–214, 218, 219, 222, 224, 291–294, 298	Homesteads.
	300	Cattle driveways.
	302	Homesteads in national forests.
	315f	Homestead entry within grazing district.
	321	Patents for desert lands.
	351, 355	Permit to explore for underground water, and develop water supply.
	374, 375	Sale of lands acquired under the "Reclamation Act"
	423e	Limitation of private ownership in irrigable land.
	424a	Area of unproductive land purchasable.

Title 43 – Public Lands etc. Continued		
	431	Water rights limitation.
	434, 447, 451e, 451h	Homesteads on irrigated land.
	471	Construction charge for irrigation.
	485h(d)(1)	New projects: Delivery of water for irrigation.
	561	Withdrawal of [irrigation project] land for town sites.
	627, 628	Federal Lands Included in State Irrigation Districts.
	641	Grants of desert land to States for reclamation.
	678, 679, 682	Price of lands.
	713, 720, 725, 727	Town or city sites.
	751	Rules of survey.
	869	Disposal of lands for public or recreational purposes.
	934	Rights-of-way through public lands granted to railroads.
	950	Right-of-way to canal and ditch companies for irrigation purposes.
	956, 957	Right-of-way for tramroads, canals or reservoirs, and electric-power companies.
	959	Rights-of-way for electrical plants, etc.
	961	Rights-of-way . . . . for power and communication facilities.
	962	Right-of-way in Colorado and Wyoming to pipe-line companies.
	981	Grants of swamp and overflowed lands.
	1025	Drainage under state law: Unentered lands.
	1068	Lands held in adverse possession.
	1076	Abandoned military reservations: Grants to municipalities.
	1091–1094	Public lands in Oklahoma.
	1155	Certificates of location of private land claims.
	1171	Sale of isolated or disconnected tracts.
	1181	Timber-culture.
	1181a	Oregon and California Railroad and Coos Bay Wagon Road Grant Lands: Conservation management by Department of Interior.
	1301	Submerged lands: Definitions.
	1312	Seaward boundaries of states.
Title 46 – Shipping:		
46 USCA	25	Form of register.
	71	Admeasurement of Vessels.
	77	Tonnage.
	85	Load lines: Establishment.
	104	Foreign yachts: exemption from tonnage taxes.
	121, 128	Amount of tonnage duties.
	151–155	Regulations as to Vessels Carrying Steerage Passengers.
	170	Regulation of carriage of explosives or other dangerous articles on vessels.
	201	Log Books: Entries.
	223	Minimum number of officers.
		Regulation of Vessels in Domestic Commerce:
	251	Vessels of the United States.
	263	Form of license.
		Inspection of Steam Vessels:
	362	Domestic and foreign vessels – laws applicable.
	390	Small Passenger-Carrying Vessels.
	395	Seagoing barges.

Title 46 – Shipping: – Continued			
		404	Inspection of ferryboats, canal boats, and small craft.
		526, 526a–526i	Motorboat Act of 1940.
Title 49 – Transportation:			
	49 USCA	211	Lease of contiguous public lands for public airports.

PART B

Agencies listing Regulations or other substantial legal areas which would be affected by U.S. metrication.

Department of the Treasury

Bureau of Customs – revision of regulations
Internal Revenue Service – revision of regulations

Department of Justice – general administrative problems of revising the U.S. Code

Bureau of Narcotics and Dangerous Drugs – revision of control regulations

Department of Agriculture – General legislation would presumably prescribe legal conversion factors. Whether regulations, instructions, records and forms would require explicit revision would depend on the circumstances in each case. Examples of regulations involving customary measures (though the relevant section of the Code does not) are: standards under the U.S. Grain Standards Act (such as in 7 CFR 26.310 and 26.317), regulations under the U.S. Warehouse Act (7 CFR 102.14 and 107.12), and regulations and orders under the Commodity Exchange Act (e.g., 17 CFR 15.03 and 150.1) and the Packers and Stockyards Act (e.g., 9 CFR 201.78–1).

Legal problems may be encountered in administering the Department's program, such as difficulty in enforcement of statutory penalties or forfeitures for failure to meet specified terms and conditions where knowledge is a necessary element, or in sustaining determinations of the amount of payments or benefits to which a farmer or producer is entitled if requirements of the program are stated in metric and he is unfamiliar with it.

Foreign Agricultural Service – redefinition of trade restrictions and incentives

Forest Service, Administration – possible difficulty with land ownership descriptions

Forest Service, National Forest System – revision of regulations, codes, agreements, easements, permits

Forest Service, State and Private Forestry – revision of national and state legal requirements regarding measurement of primary and finished timber products

Programs and Legislative Report—support of other offices in amendment of orders

Department of Commerce

Maritime Administration—regulations concerning Federal maritime aids

National Bureau of Standards—

Building Research Division—revision of reference standards and development of technical base for standards used in building codes. Rewriting of Federal construction specifications.

Office of Standard Reference Materials—(some legal requirements for use of Standard Reference Materials (SRM's) and the Office required by law to publish any changes in SRM's.) Many standards are already in metric. Exceptions: standard flourspar, against which aluminum customs are collected; air pollution (mixed usage); magnetic tape (mixed usage); some other engineering-type standards.

Office of Weights and Measures—NBS Handbook 44: tolerances on commercial weighing and measuring devices (revised yearly).

Office of Engineering Standards Services and Office of Weights and Measures—renegotiation (with industry) of simplified quantity recommendations and voluntary product standards pursuant to the Fair Packaging and Labeling Act, 15 USCA 1451.

Department of Health, Education and Welfare

Food and Drug Administration, Office of Pesticides and Product Safety—revision of Title 21 of the Code of Federal Regulations, covering food standards

Health Services and Mental Health Administration—regulations covering: Grants: (1) for construction and modernization of hospitals and medical facilities; (2) for construction of university-affiliated facilities for the mentally retarded; (3) for construction of facilities for the mentally retarded (general); (4) for construction of community mental health centers. Quarantine and inspection: (1) foreign (a) sanitary inspection: control of rodents, insects and other vermin; disinfection; (b) special provisions relating to ports and airports; and (2) interstate (a) definitions, general provisions; (b) shipment of certain things; (c) vessels: sanitary facilities and conditions; (d) land and air conveyances and vessels: food.

Department of Housing and Urban Development

Regulations: 24 CFR 201.520 (c) as amended at 35 F.R. 17545 (Mobile Home Loans); 24 CFR 1710.10 (b) and (k) (Interstate Land Sales Full Disclosure)

Numerous other materials contain guidelines and technical standards involving measurement terms.

Department of Transportation

Office of the Secretary, Office of Hazardous Materials—substantial volume of regulations (and specifications) governing transportation of hazardous materials (implementing 18 USCA 831-835).

Federal Aviation Administration—Engineering and Manufacturing Regulations, Sections 21, 23, 25; Handbooks; Operating Rules—Part 61 (pilots), Part 93 (air traffic).

Federal Railroad Administration—regulations implementing 45 USC 1-16, "Safety Appliances Act"; monitoring industry revision of the Interchange Rules (voluntary standards assuring compatibility of rolling stock).

Atomic Energy Commission—minor revision of regulations (e.g., transportation of radioactive materials).

Federal Trade Commission—implementation of revised Fair Packaging and Labeling Act, 15 USC 1451.

Interstate Commerce Commission—Title 49 of the Code of Federal Regulations—tariff compiling rules; Large volume of tariffs on file would have to be revised and republished by the industry.

United States Postal Service—The "Postal Reorganization Act," Public Law 91-375, USC Title 39, gives the United States Postal Service authority and prescribes its mechanism for specifying classes and rates for mail.

Veterans Administration—construction criteria in regulations governing grants to states for domiciliary facilities.

United States Tariff Commission—renegotiation of trade agreements; preparation of revised Tariff Schedules for Congressional enactment.

Appendix 7

AGENCY CHAPTERS *

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*The Office of Management and Budget did not fill out a questionnaire or submit an agency summary, but responded by letter that it would not expect to be significantly affected by metrication.

DEPARTMENT OF STATE

Liaison Representative:

Addison E. Richmond, Jr., Bureau of International Scientific and Technological Affairs

Respondents — Internal Operations:

1. Office of the Deputy Assistant Secretary for Communications
2. Office of the Director, Office of Foreign Buildings

Respondent — International Trade Area of National Responsibility:

1. Division of Special Trade Activities and Commercial Treaties, Bureau of Economic Affairs

1. Mission of the State Department. The Secretary of State is the principal advisor to the President in the determination and execution of the foreign policy of the United States with, *inter alia*, responsibility to the full extent permitted by law for overall direction, coordination, and supervision of interdepartmental activities of the United States Government overseas, except for certain military activities. The Department of State provides the administrative framework for advising and supporting the Secretary in his responsibilities and for conducting the foreign affairs of the United States.

2. Effect of Metrication on the Internal Operations of the State Department. Adoption of the metric system would directly affect operations in two specific areas within the Department of State: the Office of Foreign Buildings and the Office of Communications.

The Office of Foreign Buildings manages, directs, and establishes policies for the overseas buildings program as authorized by the Foreign Service Building Act. In carrying out its responsibilities, this Office, *inter alia*, initiates and develops plans for construction and acquisition programs, including establishing standards, providing technical guidance, and executing architectural and construction contracts. Metric units of measurement are currently used by this Office in the design of buildings which are to be built in foreign countries. Since most of this construction work is done by local contractors, and since the metric system is used in most of the countries in which the Office of Foreign Buildings has responsibilities, this Office has considerable experience with metric units and standards The Office specifies cost savings, operational improvement, legal requirements, and international cooperation to be the reasons for its use of the metric system. The Office, however, does not plan unilaterally to increase its use of the metric system. In the absence of any changes toward metric usage, the Office anticipates problems of dual dimensioning, waste, increased conversions, and increased interfacing.

If there were a nationally coordinated program to increase use of metric units and engineering standards over a 10-year period, this Office believes that there would be no cost impacts. Such a transition is expected to facilitate the application of U.S. standards internationally, improve international communications, and save costs and time in the conversion of technical requirements formulated in the U.S. to metric units. No other major effect in the operation of this Office is anticipated.

The Office of Communications directs the establishment and execution of plans, policies, and programs to provide the Department of State with a world-wide communications system. Currently, the Office does not use metric units or standards in any of its activities and does not plan to adopt them unilaterally in the future. In the absence of any changes toward metric usage, the Office anticipates problems of dual dimensioning, increased conversions, and increased interfacing.

If there were a nationally coordinated program to increase use of metric units of measurement and metric engineering standards over a 10-year period, the Office estimates that there would be a 9 percent increase in its annual costs during the transition period. Annual added costs are estimated to total $99,000 ($80,000 for engineering, $15,000 for maintenance and tools, and $4,000 for training). Conversion to the metric system would save costs in the long-run by making it easier to maintain U.S. manufactured equipment overseas and by increasing the ease of measurement and calculation involved. For the short term, however, costs would increase if the metric system were adopted because of the need to procure new tools, standards, and hardware, changes in engineering design, and increased personnel training costs.

In the State Department, the activities of those offices which are responsible for the planning, construction, installation, and maintenance of buildings and facilities would be affected by the adoption of the metric system. The introduction of metric measurements and standards would facilitate these activities, which are largely overseas, by increasing the "compatibility" of U.S. equipment, plans, and standards with services and hardware available in "metric" countries. After initial cost increases resulting from the need to accommodate men, equipment, and techniques to the new system, there would be a net financial benefit.

It is unlikely that the Department of State would adopt the metric system for its own use in advance of national U.S. adoption, but the Department generally favors implementation of the metric system.

Impact of Metrication on International Trade

As the Bureau within the State Department charged with formulating and implementing U.S. foreign economic policy, the Bureau of Economic Affairs sees several advantages to the United States from a trade standpoint to be gained from metrication. It is also clear, however, that the costs would be substantial. The Bureau is not in a position to perform a cost-benefit analysis of metrication nor is it in a position to quantify the benefits of metrication.

It is the experience of the Bureau that a diversity of standards or units of measure among several nations acts as a barrier to trade while uniformity of units and standards helps it. The Bureau believes, therefore, that metrication would tend to advance the economic goals of the United States and improve well-being in the world at large by removing a "trade barrier" and encouraging a freer flow of goods and services among the nations of the world.

Most of the export markets for the United States are on the metric system, and both the relative and absolute importance of these markets are growing constantly. Adoption of the metric system, including metric standards, by eliminating the need for "dual manufacturing," unit conversions, the cost of extra calculations, and the need to quote prices or bids in unfamiliar terms, should increase the opportunity for the marketing of U.S. products.

Conclusion. The Bureau of Economic Affairs believes that adoption of the metric system would in all probability tend to increase the exportability of and overseas markets for U.S. manufactured goods; this would influence the development of U.S. foreign trade policy.

DEPARTMENT OF THE TREASURY

Liaison Representative:

John J. Coughlin, Acting Director, Office of Administrative Services

Respondents — Internal Operations:

1. Assistant Commissioner (Planning and Research), Internal Revenue Service
2. Facilities Management Division, Internal Revenue Service
3. Administrative Assistant to the Comptroller, Comptroller of the Currency
4. Office of Engineering, Bureau of Engraving and Printing
5. Bureau of the Public Debt
6. Technical Development Branch, Management and Organization Division, U.S. Secret Service
7. Management Analysis Division, Bureau of Customs
8. Technical Division, Bureau of the Mint

Respondent — International Affairs and Trade Area of National Responsibility:

1. Division of International Economic Activities

Respondents — Taxation Area of National Responsibility:

1. Assistant Director, Office of Tax Analysis
2. Excise Taxation Staff, Office of Tax Analysis

1. Mission of the Treasury Department. The Treasury Department, looked at broadly, performs three basic functions.

As a major policy advisor to the President, the Secretary of the Treasury has primary responsibility for: formulating and recommending domestic and international financial policy, formulating and recommending tax policy, participating in the formulation of broad fiscal policies that have general significance for the economy, and managing the public debt.

As a financial agent for the U.S. Government, the Department performs a variety of fiscal service operations including: accounting for public moneys; issuing and processing Government checks; issuing and promoting the sale of savings bonds and other securities; collecting tax revenues and customs duties; supervising the national banks; and manufacturing coins, currency and postage stamps.

As a law enforcement agency, the Treasury directs the U.S. Secret Service and detects and arrests counterfeiters, smugglers, bootleggers, and forgers of Government checks or securities.

2. Extent of Present Metric Usage. At the present time metric measurement units are used for invoices for imported merchandise; laboratory activities; specifications and maintenance of electrical and mechanical equipment; chemical formulae; and photographic activities. Metric engineering standards are used for specifications for laboratory equipment and reagent chemicals; tests of properties of paper products; laboratory activities; research and development projects; and photographic and production standards.

The advantages of present metric usage are widespread. Operational improvement, facilitated international cooperation, and simpler calculation are the most often cited advantages.

The disadvantages associated with present metric usage are lack of familiarity with the metric system on the behalf of some personnel, costs of conversion, and the difficulty of obtaining replacement fittings for printing presses manufactured in Europe.

All respondents of the Treasury Department currently using the metric system judge the advantages of metric usage to outweigh the disadvantages. However, with the exception of the tests of properties of paper products, there is no trend at present toward wider use of the metric system.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). The Treasury Department does not plan to unilaterally expand its use of the metric system if there is no national plan for adopting the metric system. The Facilities Management Division of the Internal Revenue Service, the Office of Engineering of the Bureau of Engraving and Printing, and the Technical Division of the Bureau of the Mint anticipate a gradual transition towards metrication in response to its adoption by industry and its increasing usage in the areas of international exchange. The respondents of the Treasury Department are unable to estimate what effects these changes would have on their internal costs. However, what costs do occur are expected to be negligible. In adapting to these changes, the main obstacles will be the need to train personnel in metric usage and the need to maintain a double inventory of equipment parts. Mission capability and standardization within the Treasury are expected to be enhanced by these changes and the advantages of metrication are expected to outweigh the disadvantages.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Those responding organizations specifying dollar amounts of annual added costs during the transition period are: Facilities Management in the Internal Revenue Service ($50,000); Comptroller of the Currency ($20,000); and Office of Engineering in the Bureau of Engraving and Printing ($50,000). The Alcohol, Tobacco, and Firearms Division of the Internal Revenue Service expects an average annual cost increase of $37,500 because of costs of revising regulations, manuals and forms. Only the Management Analysis Division of the Bureau of Customs anticipates savings ($30,000 annually) during this period. The total estimated net average annual added cost for the Treasury Department during the transition period is about $127,500.

During the post-transition period the Bureau of Engraving and Printing anticipates annual added costs of $15,000. The Facilities Management Division of the Internal Revenue Service expects an annual savings of $25,000 and the Management Analysis Division of the Bureau of Customs anticipates annual savings of $30,000. The Alcohol, Tobacco and Firearms Division of the Internal Revenue Service expects "negligible" cost increases during the post-transition period. Thus, the total net annual savings during the post-transition period for the Treasury Department would be about $40,000.

To effect a changeover to metric units of measurement, the Treasury would have to modify some of its forms and files, acquire equipment with metric specifications, orient personnel in metric usage, and increase certain inventories so dual systems can be maintained during the transition period.

Transition to metric units of measurement would result in operational improvement and some cost decreases. No serious disadvantages are anticipated and the advantages of such a transition are estimated to outweigh the disadvantages.

Changeover to metric units of measurement could be implemented principally by changing specifications in the procurement of equipment and supplies. In the customs area, regulations would have to be revised.

No legal or other significant problems are foreseen in the event of a nationally coordinated program to increase usage of metric units of measurement.

5. Anticipated Impact Under a Nationally Coordinated Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Measurement (Assumption III). During the transition period of such a program, annual costs are expected to increase somewhat over $140,000. The Facilities Management Division of the Internal Revenue Service anticipates annual cost increases of $50,000; the Comptroller of the Currency anticipates annual cost increases of $20,000; the Office of Engineering in the Bureau of Engraving and Printing anticipates annual cost increases of $50,000; and the Alcohol, Tobacco, and Firearms Division of the Internal Revenue Service anticipates average annual cost increases of about $51,600 (mostly for purchasing of laboratory equipment) during the transition period. There would be an average annual savings of about $30,000 for the Bureau of Customs during the transition period.

During the post-transition period, the Facilities Management group in the Internal Revenue Service anticipates annual added costs of $50,000, while the Office of Engineering in the Bureau of Engraving and Printing expects annual savings of $27,000 and the Bureau of Customs expects annual savings of $30,000. The total net annual savings for the Treasury Department during the post-transition would be about $7,000.

To effect a transition to metric-based engineering standards as well as units of measurement, the Treasury Department would have to follow the same procedures involved in a transition to metric units only. The advantages and disadvantages of such a transition would also be identical to those of a changeover to metric units. The advantages are expected to outweigh the disadvantages. The same procedures would be followed in implementing a changeover to metric-based engineering standards as would be followed in implementing a transition to metric units of measurement. No legal problems are foreseen which might result from a transition to metric engineering standards and measurement units.

6. Conclusion. The respondents of the Treasury Department recommend adoption of a nationally coordinated program of transition to metric units of measurement and metric-based engineering standards.

Impacts of Metrication on International Affairs and Trade

The increased use of the metric system, under the auspices of a coordinated national program, would probably increase U.S. exports by facilitating access of U.S. products to markets of countries which utilize the metric system. Imports might also increase, but the increase would not be significant. Given the vast size of the U.S. market, foreign producers presently make the adjustments in their products necessary to sell them in the U.S. under the English system. The overall impact on the U.S. balance of payments of a harmonized, worldwide measurement system would be favorable.

Impacts of Metrication on Taxation

Present Metric Usage. At present the metric system is used to a limited extent (less than one-fourth of all activities) in the field of taxation. There are no discernible trends in metric usage in this area.

The impact of metrication on the field of taxation and on the Treasury's ability to perform its mission within this field has been *negligible*.[1]

Future Impacts of Metrication. If no national program for transition to the metric system is adopted, increasing domestic and international use of the metric system is likely to have little or no effect on the field of taxation.

In the event of a nationally coordinated program for transition to the metric system over a 10-year period, the Treasury Department would have to adapt the relevant tax laws, forms and regulations. Special attention would have to be given to the adaptation of specific excise tax rates. It cannot be estimated whether or not such a transition would improve the Treasury's effectiveness within the field of taxation.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

DEPARTMENT OF JUSTICE (DOJ)

Liaison Representative:

Louis A. Mayo, Jr., Center for Criminal Justice Operations and Management, Law Enforcement Assistance Administration

Respondents — Internal Operations:

1. Bureau of Narcotics and Dangerous Drugs
2. Federal Bureau of Prisons
3. Engineering Branch, Immigration and Naturalization Service

1. Mission of the Department of Justice. The chief purposes of the DOJ are to provide means for the enforcement of the Federal laws, to furnish legal counsel in Federal cases, and to construe the laws under which other Departments act. DOJ conducts all suits in the Supreme Court in which the United States is concerned, supervises the Federal penal institutions, and investigates and detects violations against Federal laws. It represents the Government in legal matters generally, rendering legal advice and opinions, upon request, to the President and to the heads of the executive departments. The Attorney General supervises and directs the activities of the United States Attorneys and Marshals in the various judicial districts. An additional major function is financial and technical assistance to non-Federal public law enforcement and criminal justice agencies.

2. Extent of Present Metric Usage. Only the Federal Bureau of Narcotics and Dangerous Drugs uses the metric system at the present time. Metric measurement units are used in reporting illicit drugs removed from the market, auditing the legitimate industry, laboratory analysis, and manufacturing and purchase quotas. Metric engineering standards are used for drug formulations.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Under this assumption, only the Bureau of Narcotics and Dangerous Drugs foresees any increased metric usage. As of June 1, 1970, the Bureau is encouraging the drug industry to increase its metric usage. Increased metric usage will facilitate the auditing of industry and the preparing of manufacture and purchase quotas. Increased metrication will improve control over narcotics and dangerous drugs, and will result in annual internal savings (probably less than 1 percent) to the Bureau. These savings will be incurred because of the reduced number of data conversions required. Thus, advantages of such changes will outweigh disadvantages.

The Federal Bureau of Prisons and the Immigration and Naturalization Service, which do not plan increased metric usage, foresee increasing problems of training and dual dimensioning because of the increasing metric usage outside the Department of Justice.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption, only the Bureau of Narcotics and Dangerous Drugs anticipates any cost impacts during the transition and post-transition periods. During the transition period, the Bureau expects a cost savings of under 1 percent or $5,000 annually for conversion activity.

The Bureau of Narcotics and Dangerous Drugs believes that long-term advantages of metrication would be cost decreases and operational improvements. The Bureau of Prisons and the Immigration and Naturalization Service believe that there would be operational improvement due to metrication.

All three DOJ respondents believe that advantages of metrication would outweigh the disadvantages because the metric system is a simpler system to use.

In order to implement the metric system under Assumption II, DOJ would have to prepare new regulations and internal guidelines; only minimum effort would be required here. The Bureau of Narcotics and Dangerous Drugs would have to revise control regulations. The Immigration and Naturalization Service points out problems relating to maintenance and equipment and retraining as minor obstacles to metrication.[1]

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). Under this assumption only the Bureau of Narcotics and Dangerous Drugs anticipates any cost impacts. On an annual basis during the transition period, there would be a net savings of $5,000. There would be increased costs of $10,000 per year for educational activities. On the other hand, there would be a savings of $15,000 per year—$10,000 for audit efficiency and $5,000 in setting quotas.

The other impacts and advantages from metrication under this assumption are identical to those under the prior assumption, except that adoption of metric standards would facilitate the policing of industry in the case of the Bureau of Narcotics and Dangerous Drugs.

6. Conclusion. In the belief that there should be concerted action to bring about changes toward metrication, DOJ recommends that the proper approach be through legislation and voluntary compliance. A 10-year transition period is seen to be adequate.

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[1] Several Federal agencies have, in the course of the metric study, mentioned the probability of some increase in the number of enforcement proceedings by the agencies (e.g., the Food and Drug Administration) due to confusion and negligence while changing to the metric system. Those cases of a criminal nature could end up in Federal Court, and thus would be an added burden on the DOJ. At this point, it is not possible to give any valid percentage increase in costs or workload to the U.S. Attorneys or Marshals (for example) from case inputs from other agencies (or, for that matter, from other sectors of the society).

DEPARTMENT OF THE INTERIOR

Liaison Representative:

Martin Prochnik, Deputy Science Advisor, Office of the Secretary

Respondents — Internal Operations:

1. Bureau of Commercial Fisheries
2. National Park Service
3. Bureau of Mines
4. Office of Coal Research
5. Geological Survey
6. Bureau of Land Management
7. Bureau of Reclamation
8. Bonneville Power Administration
9. Office of Saline Water
10. Federal Water Quality Administration

Respondents — Energy Technology Area of National Responsibility:

1. Commissioner of Reclamation
2. Assistant to Commissioner (of Reclamation) — Research
3. Acting Administrator, Bonneville Power Administration
4. Assistant Chief of Systems Engineering — Research and Development, Bonneville Power Administration
5. Deputy Administrator, Southwestern Power Administration
6. Branch of Maintenance, Southwestern Power Administration
7. Design Section, Branch of Design and Specifications, Southwestern Power Administration
8. Office of Assistant Secretary for Mineral Resources
9. Administrator, Alaska Power Administration
10. Project Development Division, Bureau of Water and Power Development — Alaska Power Administration
11. Power Division, Bureau of Water and Power Development, Alaska Power Administration

Respondent — Water Pollution Control Area of National Responsibility:

1. Division of Process Research and Development, Federal Water Quality Administration

Respondents — Food and Fiber (Fishing Industry) Area of National Responsibility:

1. Director, Bureau of Commercial Fisheries

2. Assistant Director for Utilization and Engineering, Bureau of Commercial Fisheries
3. Division of Food Science, Bureau of Commercial Fisheries

1. Mission of the Department of the Interior. The Department of the Interior is concerned with the management, conservation and development of the Nation's water, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

Most aspects of Interior's mission will be affected to some degree by metrication. The U.S. Geological Survey, Bureau of Mines, Bureau of Commercial Fisheries, Bureau of Sport Fisheries and Wildlife, Office of Coal Research, Bureau of Reclamation, Office of Saline Water and the Federal Water Quality Administration have the most significant research and development functions of the Department and can, therefore, be expected to bear the largest impact of metrication. The land survey responsibilities of the Bureau of Land Management would be affected by metrication. The Bonneville Power Administration, along with these nine organizations, is included in the "Internal Operations" Survey.

2. Extent of the Present Metric Usage. All 10 of the responding Interior Bureaus and Offices cited above use the metric system to a limited extent. Eight of the 10 subdivisions[1] use metric-based engineering standards. The metric system is generally used in internal and contract research projects in technical areas where the metric system is universally used and where contact with the public is not a primary mission. Examples of such use are laboratory measurements and calculations, photogrammetry, and electronic distance measuring. Some of the Department's publications use metric units. Metric standards are used in testing materials by American Society for Testing and Materials standard methods.

Advantages most often cited for present metric usage include: improved relationships to the main body of science, improved international cooperation, and operational improvement. Only the Bureau of Commercial Fisheries cites cost savings as a reason for metric usage. Most respondents cite no disadvantages in the present use of the metric system. In the few instances where disadvantages are cited, it was pointed out that difficulties are limited to metric engineering standards. The main problem appears to be the tendency by both industry and individuals to prefer customary standards because of unfamiliarity with metric measurements.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). If there is no concerted national action for increasing the use of the metric system, there will, nevertheless, be significant movements toward metrication in the Department of the Interior. The Bureau of Commercial Fisheries and the civil engineering activities of the National Park Service foresee total conversion to the metric system in their agency operations. Both feel that there will be time and cost savings due to metrication because of the increasing worldwide and domestic metric usage.

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[1] The two which do not use metric-based engineering standards are: Office of Coal Research and the Bureau of Land Management.

The Bureau of Reclamation, the Bonneville Power Administration, and the Federal Water Quality Administration foresee less dramatic moves to further metric usage. In these cases, the anticipated changes will basically involve greater metric usage in publications. An exception is that the Bonneville Power Administration will make increasingly greater usage of metric standards, especially in light of its heavy purchases of foreign-made metric-based equipment.

If the agencies make no changes toward further metric usage under Assumption I, eight of the 10 respondents predict problems of increasing intensity. The problems most often mentioned are increased use of dual dimensioning, more dual inventories, greater difficulties in international cooperation, and increased conversion and interfacing difficulties.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). Under this assumption the Interior respondents find it difficult to specify cost impacts on the Department. Seven of the respondents (Bureau of Mines, Office of Coal Research, Bureau of Land Management, Bureau of Commercial Fisheries, Office of Saline Water, Federal Water Quality Administration, and the Bureau of Reclamation) do not foresee any internal savings or added costs for their agencies resulting from metrication under Assumption II.

Only three respondents believe that there would be any cost impacts due to metrication under Assumption II. The National Park Service anticipates cost increases of less than 1 percent during the transition period. Costs would increase by $125,000 annually due to an increase of $5,000 for specification activities, $15,000 for work on signs, $5,000 for contract work, and $100,000 for land acquisition activities. During the post-transition there would be annual added costs of $50,000 for land acquisition activities.

The Geological Survey reports that costs would increase by 1 to 5 percent during the transition period (due to extra costs of $2 million for data collection and processing in dual system) and that there would be no effect on costs during the post-transition period. The Bonneville Power Administration thinks that there would be no net cost impact during the transition, but that there would be a savings of about $90,000 per year or 1 to 5 percent during the post-transition period.

Eight of the 10 respondents cite long-term advantages due to metrication. Cost decreases, operational improvements, promotion of U.S. standards internationally, improved international communication, and increases in international trade are all cited as advantages.

Only the Bureau of Land Management sees any long-term disadvantages. There would be the problem of the inconsistency between the metric system and the established system of land measurement in the United States, based as it is on the statute mile, which is subdivided into 80 chains. However, the Bureau observes that our customary land measures could be expressed in metric units, since all resurveys result in fractions of chains and fractions of acres, and these are carried only to the nearest one-hundredth (0.01) of a chain or acre. The Bureau states that, "Providing no attempt is made to change all past records, no problems are anticipated if future work were to be based on the metric system."

All respondents except those at the Bureau of Land Management and the Office of Coal Research believe that the advantages would outweigh the disadvantages; the Bureau of Land Management says advantages would not outweigh disadvantages and the Office of Coal Research is uncertain whether or not advantages would outweigh disadvantages.

Under Assumption II, the respondents at the Bureau of Commercial Fisheries, National Park Service, Bureau of Mines, Geological Survey, and the Bonneville Power Administration foresee problems of educating and retraining their employees, operational problems, and problems dealing with maintenance and equipment. Also, work production may be slowed to some extent during the transition period. Basic U.S. land survey laws would have to be changed and there would be several other legal requirements contained in enacted legislation that would have to be changed.

The main problem of adopting metric units is simply one of adaptation by people, both employees and clients, to an unfamiliar system. Long-life equipment, however, may also cause continued use of a dual system under Assumption II within some Interior activities.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). With regard to cost impacts on the Department of the Interior, eight of the 10 respondents give the same replies under Assumption III as they give under Assumption II. The two respondents (National Park Service and the Geological Survey) report under Assumption III slightly different increased costs than under Assumption II.

The National Park Service expects annual added costs of $127,000 during the transition period under Assumption III as against $125,000 annual added costs under Assumption II. For the post-transition period, land acquisition standards annual costs would increase by $50,000 under Assumption II; under Assumption III, the increase in annual costs would be "negligible."

The Geological Survey anticipates that added costs would be $3 million per year due to added costs for collection, processing, and dual dimensioning under Assumption III; under Assumption II, costs would go up by $2 million within the collection, processing and dual dimensioning areas.

The long-term advantages of metrication reported under Assumption III would be nearly identical to those given under Assumption II. The Bonneville Power Administration says that advantages coming under Assumption III, but not under Assumption II, would be an eventual unification of standards throughout the world and a greater interchangeability of parts.

Seven of the 10 respondents believe that the advantages of metrication under Assumption III would outweigh the disadvantages; the Bureau of Land Management says the advantages would not predominate, and two (the Office of Coal Research and the Federal Water Quality Administration) are uncertain. All respondents except the Federal Water Quality Administration give the same answer to the question of whether advantages would outweigh disadvantages under Assumption III as they do under Assumption II.

Generally, the respondents believe that the impacts under Assumption III (changes to metric standards as well as to metric units) would be similar to those under Assumption II (changes in language only). There would be somewhat greater problems under Assumption III because retooling, changes from customary physical sizes to metric, and dual inventories would be required in addition to the problems listed under Assumption II.

6. Conclusion. Eight of the 10 respondents favor concerted national action to bring about changes toward metrication in measurement units. The Bureau of Land Management is uncertain whether there should be such action; the Office of Coal Research expresses no opinion.

Six[2] of the 10 respondents definitely favor a concerted program to bring about changes toward metrication in engineering standards. The Bureau of Land Management, the Office of Saline Water, and the Federal Water Quality Administration are undecided whether there should be a concerted program. The Office of Coal Research expresses no opinion.

There is general agreement that conversion to the metric system should be enacted through a legislated program. Included in the plan for metrication should be a well-planned program of education and training, coordinated action by technical societies, governmental procurement in metric measures and achievement of a consensus of government, management, and labor on what changes should be made.

Most responding agencies are satisfied with 10 years as a transition period. The National Park Service and the Bonneville Power Administration, the only two agencies which definitely prefer a different transition period, suggest shorter periods in order to minimize costs and disruption.

Impacts of Metrication on Energy Technology

Present Metric Usage. At present the metric system is used in less than 25 percent of all work activities in the energy field in the United States. Except for the Southwestern Power Administration and the Bonneville Power Administration, there is no significant trend toward metric usage within Interior offices[3] which deal with energy.

The Southwestern Power Administration says that most foreign-produced power equipment is constructed to metric dimensions and that some domestic manufacturers are now producing equipment according to metric dimensions. The Bonneville Power Administration believes that field maintenance personnel are becoming increasingly familiar with the metric system because of the increasing use of metric parts and equipment.

Impact on the energy field from current trends toward metrication is seen as *moderate*[4] for most activities and is related to the difficulties of increased use of foreign equipment and maintenance parts. Impact on some activities (e.g., converting dimensions from non-metric in order to reconcile data on engineering drawings when applying new equipment in existing facilities) is *negligible*. The impact on project development activities is *trivial*.

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[2] These are: Bureau of Commercial Fisheries, National Park Service, Bureau of Mines, Geological Survey, Bureau of Reclamation, and Bonneville Power Administration.

[3] Five Interior organizations provided information on Energy Technology: Bonneville Power Administration, Alaska Power Administration, Southwestern Power Administration, Bureau of Reclamation, and Office of Mineral Resources.

[4] See "Classification of Intensities of Impact" scale on p. 79.

Future Impacts of Metrication. There is little question that pressure toward increased use of the metric system will increasingly affect energy technology to a significant degree. Assuming that there will be no concerted national action to increase metric usage, all of the responding agencies believe there will be greater usage of metric threads which will require duplicate stocks of bolts and screws. There will be minor inconvenience in coordinating non-metric and metric dimensions on technical drawings and data, and there will be some duplication of tools. On the other hand, some advantages will result from the increasing metric usage: e.g., increasing simplicity in computation and recording of technical information and measurements. Already, there is a trend toward an increasing international standardization of engineering units in the metric system by the Institute of Electrical and Electronic Engineers and other technical societies.

The respondents believe that the impact on their agencies' ability to perform their missions if there is no concerted national program will, in most cases, be slight. There will be a moderate increase in costs because of increased spare-part inventories, additional tools, and engineering drawing changes. The Office of Mineral Resources estimates the impacts to be *negligible*, the Southwestern Power Administration estimates the impact to be *trivial*, and the other three estimate impacts to be *moderate*.

If there were a concerted national effort to increase the use of the metric system, initial disadvantages are expected, but they would be offset by the faster accumulation of benefits provided by the metric system. Problems would especially arise when replacements for equipment become necessary. Duplicate spare parts and tools would be required. Additional effort would be required to convert technical data, drawings, and maintenance procedures.

A longer transition period than 10 years would mean that less immediate effort would be required for converting to the metric system since there would be time for orderly conversion of technical data, maintenance procedures, etc. On the other hand, the disadvantages of the dual system would be extended over a longer period, thereby increasing the total costs involved. The optimum period would be determined, most probably, by equipment wear-out time. However, a generating unit or other large piece of equipment of domestic manufacture could last longer than 30 years if it is maintained properly.

Benefits, over the long run, of doing away with the dual system are: increasing international standardization of engineering units and standards by technical societies; uniform and simpler engineering calculations; and better international cooperation.

The Office of Mineral Resources sees little difficulty for the utility industry in changing completely to the metric system. "However, when it comes to the suppliers of materials and equipment for the utility industry, it is expected that changes would be extensive in such things as bolt sizes, and wire and cable sizes."

Three of the five responding agencies believe that the adoption of the metric system would improve their effectiveness in the performance of their missions. The Alaska Power Administration anticipates impaired effectiveness only in the operations and maintenance areas. The Office of Mineral Resources is uncertain whether effectiveness would be improved or impaired, since there would be "apparently a minor effect."

What Action Should Be Taken? Four of the five responding agencies strongly believe that there should be a concerted national program to increase the use of the metric system in the United States. The fifth, the Office of Mineral Resources, simply replies "no."

Impacts of Metrication on Water Pollution Control

Present Metric Usage. According to the Federal Water Quality Administration, the metric system is used by between one-quarter and three-quarters of the work activities in water pollution control. There is an increasing trend toward metric usage; there is now complete use in scientific research within the pollution control field, and use in engineering is increasing at a slow rate. The impact on the water pollution control field has been *moderate*.

As the Agency increases the use of technology developed in metric-using countries, the Agency's use of the customary system has increasingly hindered technology transfer. The impact of this increasing metrication on the Federal Water Quality Administration's ability to perform its mission has been *moderate*.

Future Impacts of Metrication. According to the Federal Water Quality Administration, a 10-year transition period would cause a severe disruption of the pollution control industry if there were a nationally planned program to increase the use of the metric system. A longer period, such as 20 years, would be preferred.

Adoption of metric measurement units and engineering standards would improve the effectiveness of the Federal Water Quality Administration in performing its mission. Metrication would provide worldwide compatibility of engineering designs and drawings.

What Action Should Be Taken? The Federal Water Quality Administration believes that the Government should encourage efforts to convert U.S. industry to the metric system.

Impacts of Metrication on the Fishing Industry

Present Metric Usage. According to the Bureau of Commercial Fisheries, the metric system is used in between one-quarter and three-quarters of work activities in the fishing industry. There is an increasing use of metric in the food research community. Several scientific journals now require all measurements to be presented in metric units. Impact of the current trend toward increased use of metric has been *trivial*. These impacts include the need to replace simple measuring devices and to change dials on scales and gauges. Most of the problems caused by metrication to date have been solved by the use of conversion charts.

Future Impacts of Metrication. The Bureau of Commercial Fisheries believes that the effects of the increasing metric usage on an evolutionary basis will be advantageous because measurements will be more and more standardized. This increasing metric usage will increasingly provide for standardization of expression of Bureau research results. There will also be uniformity of terminology in international food standards. The impact on mission capability will be *moderate*.

If there is a nationally planned program to increase the use of the metric system over a 10-year transition period, many practical difficulties would result within industry. Costly conversion or replacement of existing equipment (e.g., weighing machines, temperature recorders) would be required prior to the time of normal replacement. A longer period would be better because it would allow for an orderly and economic transition to the metric system.

Adoption of metric measurement units and engineering standards would improve the effectiveness of the Bureau of Commercial Fisheries in performing its mission. Technical information disseminated to clientele would be standardized. This would be particularly true in the area of international food standards published in CODEX ALIMENTARIUS in which the metric system is used. The Bureau of Commercial Fisheries plays a significant role in the development of these standards.

What Action Should Be Taken? The Bureau of Commercial Fisheries thinks that Federal agency publications should require that all data be expressed in metric units, with parenthetical expression of customary system measurements on an optional basis.

DEPARTMENT OF AGRICULTURE (USDA)

Liaison Representative:

Earl E. Houseman, Director, Standards and Research Division, Statistical Reporting Service

Respondents — Internal Operations:

1. Agricultural Research Service
2. Agricultural Stabilization and Conservation Service
3. Commodity Exchange Authority
4. Consumer and Marketing Service
5. Cooperative State Research Service
6. Foreign Regional Analysis Division, Economic Research Service
7. Marketing Economics Division, Economic Research Service
8. Economic Statistical Analysis Division, Economic Research Service
9. Foreign Development and Trade Division, Economic Research Service
10. Farm Production Economics Division, Economic Research Service
11. Export Marketing Service
12. Federal Crop Insurance Corporation
13. Foreign Agricultural Service
14. State and Private Forestry, Forest Service
15. National Forest System, Forest Service
16. Administration, Forest Service
17. Programs and Legislative Report, Forest Service
18. Research, Forest Service
19. Rural Electrification Administration
20. Soil Conservation Service
21. Statistical Reporting Service
22. Extension Service
23. Packers and Stockyards Administration

Respondents — Consumer Affairs Area of National Responsibility:

All agencies listed as respondents for internal operations

Respondents — Food and Fiber Area of National Responsibility:

All agencies listed as respondents for internal operations

Respondents — Environmental Pollution Control Area of National Responsibility:

Environmental Quality Executive Committee, USDA

Respondents — International Affairs Area of National Responsibility:

1. Economic Research Service
2. Export Marketing Service
3. Foreign Agricultural Service
4. Foreign Economic Development Service

1. Mission of the USDA. The Department of Agriculture is concerned with production and distribution of food and fiber, conservation of natural resources, management of National Forest lands, stabilization of farm prices and income, development of rural areas, regulation of markets and trade in farm products and facilities, expansion of foreign markets, research relevant to its mission, and the dissemination of information about agriculture to farmers and the public.

2. Extent of Present Metric Usage. Eleven[1] of the 23 respondents report that they use metric units in some of their activities; only one (the Agricultural Research Service) uses metric engineering standards. Present USDA metric usage is limited primarily to two areas: (1) research in the natural sciences and measurements made in laboratories and (2) international affairs, especially international trade and statistics for international comparisons. Several metric standards of the American Society of Agricultural Engineers and of the Society of Automotive Engineers are used by the Agricultural Research Service.

All 11 of those using metric units report advantages. The advantages most often cited are operational improvement, international cooperation, and compatibility with scientific usage. The Agricultural Research Service says that metric engineering standards are used to satisfy legal requirements and for international cooperation. Three respondents cite disadvantages to their present use of metric units. Lack of familiarization on the part of the personnel and/or clients is the principal disadvantage. As a consequence, much dual dimensioning is now required in order to interface with the customary system. Agricultural engineers have formally adopted dual dimensioning.

The Agricultural Research Service says that lack of familiarization is a disadvantage with respect to the use of metric engineering standards; however, advantages of present use outweigh disadvantages. All 11 of those responding organizations which use metric units believe that the advantages of present usage outweigh disadvantages.

The present situation requires conversion or dual dimensioning for international statistics on production and international trade for nearly all commodities. In international affairs, the constant problem of conversion is unavoidable unless a complete change to the metric system occurs. A small reduction in internal operating costs and improved international communication and cooperation are seen as long-term advantages of metrication. Nearly all exporting countries use metric units or have announced plans to adopt metric units for foreign trade statistics. Practically all statistics published by international organizations are now published in metric units.

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[1] These are: Agricultural Research Service; Agricultural Stabilization and Conservation Service; Consumer and Marketing Service; Foreign Regional Analysis Division, Marketing Economics Division, and Foreign Development and Trade Division in the Economic Research Service; Export Marketing Service; Foreign Agricultural Service; National Forest System, and Research in the Forest Service; and Soil Conservation Service.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Increased involvement in international affairs and the trend to world-wide usage of the metric system have necessitated more extensive metric usage in agriculture. Other than additional uses required for interfacing with activities in which the metric system is used, USDA anticipates very little increased metric usage in agriculture without a concerted national effort. In general, the Department believes that dual dimensioning should not be encouraged except for planned transition to the metric system. In some cases, the problems created are more than just matters of cost. For example, confusion or error as to whether a spray residue tolerance is expressed in grains or grams can have serious consequences.

Only six of the 23 respondents say they plan increased metric usage in their activities. Fifteen responding subdivisions do not plan further use of the metric system. The six organizations planning further use are: Marketing Economics Division in the Economics Research Service; the Foreign Development and Trade Division in the Economic Research Service (estimated 25 percent increase in mission capability is anticipated); Export Marketing Service; Foreign Agricultural Service (estimated 10 percent increase in mission capability is anticipated); Research in the Forest Service; and the Extension Service.

Sixteen of the 23 respondents anticipate problems if no changes toward metrication are made, because of the increasing metric usage outside of USDA. Most common are: training of personnel, dual dimensioning, hindered international cooperation, and increased conversion. Three respondents say that there would be no significant problems; four do not provide any information on this point.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption 17 USDA respondents anticipate savings or increased costs during the transition period and six respondents anticipate no cost impacts.

Three subdivisions (the Foreign Development and Trade Division of the Economic Research Service, the Export Marketing Service, and the Foreign Agricultural Service) anticipate internal savings during the transition period. In two cases, annual internal savings of 1 to 5 percent are expected. The Foreign Development and Trade Division reports an annual savings of $5,000 for trade statistics work and $5,000 for foreign statistics work. In the case of the Foreign Agricultural Service an annual savings of about $10,000 would result from not having to convert and publish both customary and metric units.

The Export Marketing Service expects a savings of under 1 percent or an annual average savings of $26,000. Actually, there would be a $40,000 cost the first year to pay for the conversion of records. Starting with the first year there would also be a $30,000 savings annually because of the elimination of the dual system.

The following respondents expect their annual costs to increase by less than 1 percent during the transition period:

a. Agricultural Stabilization and Conservation Service – in areas of loans, price support, inventory management, and sales.
b. Cooperative State Research Service.
c. National Forest System in the Forest Service – almost no cost impact.
d. Programs and Legislative Report in the Forest Service – $500 annually for converting historical data.
e. Rural Electrification Administration – revision of existing engineering and operations publications. (Engineering costs would increase by $5,000 per year and administrative costs would also increase by $5,000.)
f. Research in the Forest Service – almost negligible cost impact.
g. Packers and Stockyards Administration – about $5,000 annually for revision of testing instructions, for testing scales, and for publishing instructions.

The following respondents expect their annual costs to increase by 1 to 5 percent during the transition period:

a. Agricultural Research Service – an annual increase totaling $2 million in areas of data conversion, equipment, training, and temporary inefficiency.
b. Marketing Economics Division of the Economic Research Service – approximately $30,000 for internal operations and $100,000 for research needed to determine how to derive greatest advantage from conversion. (1 to 5 percent increase for data recording in dual system, 100 percent increase for conversion of data bases, 100 percent increase in training expenses, and 100 percent increase in adaptation of ADP systems and controls to SI.)
c. Economic and Statistical Analysis Division of the Economic Research Service – an annual added cost of $40,000 for statistical activities.
d. State and Private Forestry – $30,000 annual added cost for forest management utilization activities and $10,000 annual added costs for forest protection activities.
e. Soil Conservation Service – a total added cost per year of $4,850,000 ($3,540,000 for conservation operations, $180,000 for watershed planning, $240,000 for river basin surveys, $640,000 for watershed works of improvement, $150,000 for Great Plains work, and $100,000 for resource conservation and development).
f. Statistical Reporting Service – an annual added cost of $56,500 ($32,500 for conversion of historical records, $6,000 for publication of historical records, $8,000 for publication of dual units, and $10,000 for reprogramming. These costs

would not spread over the full 10-year period, but would be concentrated toward the end of the period).

g. Extension Service – $1 million annual added cost for adult and youth education.

During the post-transition period, 13 respondents expect changes in their annual costs and 10 expect no changes. Of the 13 respondents expecting cost changes, 10 respondents expect cost savings and three anticipate added costs.

The following respondents expect an annual savings of under 1 percent during the post-transition period:

a. Agricultural Stabilization and Conservation Service – very small savings in loans, price support, inventory management, and sales activities.
b. National Forest System of the Forest Service – almost no cost impact.
c. Rural Electrification Administration.
d. Extension Service – almost no savings.
e. Marketing Economics Division of the Economic Research Service – an annual savings of about $10,000 for simplification.
f. Export Marketing Service – an annual savings of about $30,000 as a result of elimination of the dual system.

The following respondents anticipate an annual savings of 1 to 5 percent during the post-transition period:

a. Agricultural Research Service – an annual savings of about $3 million since the interface conversions would no longer be necessary.
b. Economic and Statistical Analysis Division of the Economic Research Service – an annual savings of $20,000 in statistical activities.

The Foreign Development and Trade Division expects an annual savings of $10,000 for foreign statistics work and $10,000 for trade statistics (or 5 to 10 percent) during the post-transition period.

The Foreign Agricultural Service predicts an annual savings of about $12,000 or about 10 percent during the post-transition period as a result of not having to convert and publish both customary and metric units.

The following two subdivisions expect added costs of less than 1 percent during the post-transition period:

a. Cooperative State Research Service
b. Soil Conservation Service

Finally, State and Private Forestry of the Forest Service expects a cost increase of 1 to 5 percent due to cost increases of $90,000 per year for forest management utilization activities and $25,000 for forest protection activities.

Thus the net average annual added cost for the entire USDA during the transition period under Assumption II would be somewhat over $8 million; the net average annual savings during the post-transition would be almost $3 million.

All respondents say that there would be long-term advantages to metrication under Assumption II. The most frequently mentioned advantages are operational improvements and improved international communication. Cost decreases and better promotion of U.S. standards internationally are also frequently mentioned. Only two respondents note any long-term disadvantages. Programs and Legislative Report in the Forest Service says that there would be some cost increase over the long term. Administration in the Forest Service maintains that metrication in units would not take care of the real problem; the real problem would be solved only through metrication in both language and hardware.

Nineteen of the 23 respondents say that advantages would outweigh the disadvantages. Only three[2] say that advantages would not outweigh the disadvantages; Programs and Legislative Report in the Forest Service is uncertain whether the advantages would outweigh the disadvantages.

If there were a planned national effort to adopt metric measurement units, 14 of the 23 responding subdivisions anticipate problems. Primary impact would be in the areas of operations, maintenance, equipment changes, and retraining. Nine of these 14 respondents say that there would be legal problems. The legal problems would usually be concerned with revision of statutes, regulations, codes, and contracts.

In order to implement the changeover, the respondents say their subdivisions would have to institute training programs, revise regulations, convert statistical series to metric, and convert historical records. Most, if not all, of the changes could be implemented by management directive.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). All but four of the 23 responding groups anticipate identical cost impacts during both transition and post-transition periods under this assumption as they did under the prior assumption.

The Cooperative State Research Service expects similar cost impacts during the transition period under both assumptions, but slightly different cost impacts during the post-transition. Under Assumption III, a less than 1 percent savings is anticipated; whereas under the prior assumption, a less than 1 percent cost increase is expected. However, the cost impacts under both assumptions are not expected to be significant.

The Marketing Economics Division in the Economic Research Service expects an annual cost increase during the transition period under Assumption III of about $230,000 due to a $200,000 increase for new research concerned with how the Division can derive the greatest benefits from planned metrication, and $30,000 for increased operating expenses. This contrasts to an annual increase of $130,000 under the prior assumption. During the post-transition period, however, the cost impacts would be identical to those described under the prior assumption.

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[2] These are: Commodity Exchange Authority, Cooperative State Research Service, and Administration in the Forest Service.

The Rural Electrification Administration expects an annual cost increase during the transition period of $5,000 to change specifications for materials and equipment items. This would be in addition to the $10,000 annual costs given under Assumption II. No significant cost impacts are expected during the post-transition period.

The Extension Service expects a cost increase of $1,500,000 per year during the transition period under Assumption III for educational activities. This is in contrast to the expected annual cost increase of $1 million during the transition under Assumption II. Under either assumption, no cost impacts are expected during the post-transition period.

The average annual added cost for the USDA under Assumption III would be about $8,700,000 during the transition period; the annual savings during the post-transition period would total almost $3 million.

Nine of the 23 respondents report long-term advantages which would result from the adoption of metric-based engineering standards. Advantages most frequently mentioned are operational improvement, and improved international communication. Cost decreases and better promotion of U.S. standards internationally are also cited. The remaining respondents' activities involve only measurements or statistics and are not concerned with engineering standards.

If there were a planned national effort to adopt metric engineering standards as well as metric measurement units, six of the 23 respondents identify legal or other problems. There would be some operational problems to be solved. Some retraining of personnel would be required. The National Forest System and the Soil Conservation Service report there would be some equipment and maintenance problems.

In order to implement the changeover, the respondents say their subdivisions would have to institute training programs, revise regulations, convert statistical series to metric, and convert historical records. In addition, engineering design changes and new standards would have to be developed. Some new equipment purchases would be necessary.

6. Conclusion. Eighteen of the 23 respondents favor a nationally coordinated program to increase the use of metric measurement units. Three respondents (Commodity Exchange Authority, Consumer and Marketing Service, and National Forest System) are neutral and two (Federal Crop Insurance Corporation and Rural Electrification Administration) provide no information.

The following types of concerted action are suggested: retraining of personnel, education in schools, publicity, use of metric in government publications and regulations, and government procurement in metric. Legislation would be required to some extent.

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Twelve[3] of the 23 respondents favor a nationally coordinated program to increase use of metric in engineering standards as well as in measurement units. Seven respondents are neutral or undecided as to whether there should be a concerted program, and four provide no information.

Only two respondents suggest concerted actions to be taken with regard to metric engineering standards which are different from those suggested with regard to metric measurement units. Administration in the Forest Service says that there should be a carefully phased integrated action by broad sectors in the United States. The Packers and Stockyards Administration believes that if units are in metric, standards must go metric.

Thirteen of the 23 respondents regard a 10-year period for metrication in *measurement units* as satisfactory. Five respondents do not report an opinion as to whether a longer or shorter period than 10 years would be preferable. Five subdivisions recommend a shorter transition period. The Marketing Economics Division suggests 3-5 years since the transition could be accomplished in less time, and benefits of change could begin sooner. The Foreign Development and Trade Division of the Economic Research Service could accomplish the transition in 5 years. The Export Marketing Service suggests a 1-2 year transition period in order to eliminate 8 or 9 more years of the dual system. The Foreign Agricultural Service believes that 5 years would be adequate to educate users. Finally, Administration in the Forest Service says that 5 years would be preferable.

With regard to the optimum period of adopting metric-based engineering standards as well as units, 13 of the 23 respondents regard a 10-year period for transition as satisfactory, three respondents do not know, and seven provide no information. Significantly, no respondent favored a longer or shorter period than 10 years. Administration in the Forest Service favors a 10-year period under Assumption III; under Assumption II it prefers a 5-year period.

Many people in the Department would like to see the United States convert to the metric system. The key problem tends to resolve into a choice between continued general use of the customary system or complete conversion to the SI metric system. Extending metric usage to additional areas of activity generally means dual dimensioning; i.e., use of the metric system in addition to, rather than in lieu of, the customary system. This does not seem feasible because advantages of the metric system may be more than offset by the disadvantages of dual dimensioning owing to the added costs and confusion of being involved in two systems. In the long run, however, agriculture has as much or more to gain than many other sectors from nationwide conversion to the metric system.

Agriculture, generally, would definitely benefit in the long run from universal adoption of the metric system. For example, there is much opportunity for improvement in marketing efficiency. Numerous conversions from one unit of measure to another are a matter of everyday practice. Agricultural products leaving the farm are sold by pound, gallon, bushel, or containers of innumerable shapes and sizes. Even a given measurement unit, bushel for example, has manifold meaning within a commodity as well as among commodities. Thus the numerous types of measurement encompassed in agriculture leave much to be desired.

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[3] These are: Agricultural Research Service; Agricultural Stabilization and Conservation Service; Cooperative State Research Service; Foreign Development and Trade Division, and Farm Production Economic Division of the Economic Research Service; Administration, Programs and Legislative Report, and Research in the Forest Service; Soil Conservation Service; Statistical Reporting Service; Extension Service; and Packers and Stockyards Administration.

The USDA believes much improvement in efficiency through simplification of relationships among units is potentially possible within the customary system. But, the disruption among those involved would be of such magnitude as to suggest direct conversion to the metric system rather than making major improvements within the customary system and later converting to metric, assuming that adoption of the metric system is in the offing. Moreover, perhaps much of the needed reform to achieve improved efficiency, understanding, and communication in marketing could be more readily accomplished in the process of converting to the metric system than in a major overhaul of the customary system.

As agriculture has much to gain, USDA support can be counted on if "going metric" becomes a national goal. In that event the Department recommends that the conversion be made as quickly as possible after thorough planning and preparation has taken place. The USDA is in accord with the distinction being made between measurement units and engineering standards. Any concerted action to convert should focus on getting the metric language and instruments into use within as short a transition period as possible—hopefully 2 or 3 years after plans and provisions for the change have been fully developed. Adoption of uniform or new standards (sizes) could be governed by obsolescence and other economic factors and follow without the necessity of a totally coordinated effort with an imposed time schedule.

Impacts on Consumer Affairs

Present Metric Usage. The metric system is used in less than one-quarter of all activities in consumer affairs. The Department of Agriculture respondents do not feel that there is any significant trend toward metric usage in consumer affairs.

The impact of the increasing worldwide and domestic use of the metric system to the present time has been *trivial.*[4] Imported packaged products, for example, are generally labelled in familiar units of weight or volume. Many show dual measurements.

Future Impacts of Metrication. Assuming no concerted national action toward increasing metric usage, the Department of Agriculture believes that there would be little effect on people as consumers of food and fiber products from domestic and foreign origins. There would also be *negligible* impact on the ability of the Department of Agriculture to perform its mission with respect to consumer affairs due to the increasing worldwide and domestic use of the metric system.

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[4] See "Classification of Intensities of Impact" scale on p. 79.

The respondents believe that the question is either continued use of the customary system or complete conversion to the metric system. They see no advantage to a national program to increase metric usage in the consumer area, assuming increased use means selective use rather than complete conversion.

If the U.S. makes a decision to convert, the USDA respondents believe that much time and effort should be spent on the development of plans that would enable conversion to metric usage in units and standards in as short a period as possible. Hopefully such conversion should take place in less than 5 years after full preparation has taken place. Adoption of metric engineering standards need not occur for all items in a specified period of time. Rather, the rate of progress toward use of metric standards would be governed by obsolescence and other economic factors and demand for change as, and after, metric language comes into general use.

The problem of being an intelligent consumer is becoming increasingly difficult with the proliferation of goods and services. After transition, communication and calculation would be more efficient and less costly and there would be less opportunity for deception regarding pricing and container sizes. Mental calculation needed to compare prices of products in different package sizes (e.g., weights in pounds and ounces) is a frustrating exercise. Persons of low intellectual ability might have the most difficulty of transition to the metric system, but in the long run, benefits to them might be relatively greater because the arithmetic is simpler. Any plans for conversion should include special provisions during the transition period for protecting the equity of parties involved in transactions and for handling a larger than average number of court cases.

The Department of Agriculture respondents say "perhaps there is more to gain from standardization of sizes of units than from adoption of metric measurement units."

The price of food to consumers and marketing costs would be two numerical indicators which could be used as measures of the impact of metrication on the consumer affairs area.

The Department of Agriculture respondents say that the adoption of metric measurement units (and/or standards) would improve the Department's effectiveness within consumer affairs, but the amount is not clearly discernible. The respondents believe, however, that in the long run, consumers would benefit considerably.

What Action Should Be Taken? The Department of Agriculture respondents suggest that the Government should help facilitate people's understanding of the metric system and its various applications. The Government should conduct formal studies of the costs and benefits of a complete changeover to the metric system.

Impacts of Metrication on Food and Fiber Production

The Department regards the impact of metrication on the small farms with little mechanization and some small agri-businesses as about the same as for consumers, the difference being primarily a matter of degree rather than kind. Hence, the impact of metrication on food and fiber production is considered primarily with reference to heavily mechanized farms, agricultural service establishments, handlers and processors of food and fiber, together with designers and manufacturers of agricultural and forestry inputs—farm equipment, processing equipment, agricultural chemicals, etc.

Present Metric Usage. The metric system is used in less than one-quarter of all activities within the food and fiber area as defined above. There is a progressively greater use, especially in foreign trade matters. Up to the present time, the impact of the increasing worldwide and domestic use of the metric system has had *trivial* impact on the food and fiber industry. In some areas, however, the impact might be classified as *negligible* or *moderate*.

Future Impacts of Metrication. The USDA respondents believe that there would be very little, if any, change during the next decade or two if no concerted national action concerning metrication is undertaken. Also, there would be very little, if any, impact on the ability of the Department of Agriculture to perform its mission with respect to the food and fiber industry. The impacts on its ability to perform its mission according to the intensity scale would be *trivial*.

The Department of Agriculture provides little response concerning the effects on the food and fiber industry of a nationally planned program to increase the use of the metric system. Costs of metrication would be reflected in prices of farm supplies, in the cost of performing custom services for farmers and, more generally, in the costs of farm production. However, the cost or savings from metrication would not be separable from the effects of other factors. The Department believes, in the long run, that adoption of the metric system would improve its effectiveness in performing its mission but the degree of improvement is not clear.

What Action Should Be Taken? The Department of Agriculture says that it does not have a sufficient information base to make a sound recommendation on what action, if any, the United States should take with respect to the increasing worldwide and domestic use of the metric system. While universal adoption of the metric system would bring long-range benefits, it is not clear that in the farm and related segments of the food and fiber industry, the net benefit would be sufficient to push for metrication limited to this sector.

Impacts on Environmental Pollution Control

Present Metric Usage. At the present time the metric system is used in less than one-fourth of all activities within the environmental pollution control field in the United States. The use varies with disciplines. In some areas, the use may be greater than 25 percent, according to the Environmental Quality Executive Committee of the Department of Agriculture.

The Committee says that there is a trend toward increasing metric usage in environmental pollution control. In nearly all technical papers, the metric system is used. Professional journals have become more insistent that data be reported in metric units. Improved international cooperation and understanding among engineers and scientists has been evolving. Water quality is increasingly being measured in terms of the metric system.

Up to the present time, the impact on the environmental pollution control field of the increasing worldwide and domestic use of the metric system has been *trivial* on the intensity scale. Some impacts have been in the *moderate* category, however. There have been some changes in measuring devices. The professional staffs have had to become more adept at making conversions between customary and metric units. Soil surveys are now published in dual languages.

Future Impacts of Metrication. If there is no concerted national action to increase metric usage, the Committee says that there will be added costs and difficulties resulting from being increasingly involved in having to work in terms of both systems. There will be a general delay in making full use of the metric system.

The impact of the increasing use of metric outside of USDA, assuming that there will be no concerted national action, will be increasing difficulties for the Department in performing its mission. There will be increasing difficulty in communication and increased costs of having two systems until a total changeover is accomplished. These impacts will be *trivial* on the classification scale.

If there is a nationally planned program to increase the use of the metric system, the Committee says that increased use would mean greater involvement with two systems, and as a result, added cost and communications difficulties. Apparently, these difficulties can be avoided only by complete conversion.

If there is a changeover, it should be made as quickly as possible, after a thorough development of plans and provisions. Except for some equipment replacement, the actual transition period should be less than 5 years, the Committee believes. The continuing cost of a dual system would overshadow the costs of quick training and change.

The Committee does not know of any numerical indicators which could be used as measures of impact of metrication on the environmental pollution control field. However, the Committee says that use of the metric system would result in greater international use of American standards for soil and water conservation practices and greater American use of other countries' technology.

Adoption of metric measurement units (and/or standards) would improve the Department's effectiveness in performing its mission with respect to the environmental pollution control field. There would be greater uniformity of construction materials. In areas of chemical usage, errors in preparation of dilutions would be minimized. Automatic data processing would be facilitated. Communications between scientists and engineers would be enhanced. International cooperation would be strengthened. Costs and errors would be less as there would be only one measurement system to deal with. If complete conversion is made, domestic operations under the metric system would be more efficient.

What Action Should Be Taken? The Committee thinks that the metric system should be adopted. The United States should establish specific target dates, develop training programs and conversion schedules, and provide technical assistance to industry and specialized groups. In cases where costs are exceedingly high due to unique technical complexities, perhaps tax adjustments could be used to expedite change.

Impacts of Metrication on International Affairs

Present Metric Usage. The Department of Agriculture's responsibility in international affairs includes: collection, compilation, analysis, and publication of statistics on world production, imports, exports, and consumption of agricultural products by countries; maintaining and expanding agricultural exports; and provision of technical assistance in agricultural development.

The USDA respondents say that in the international affairs areas, a dual system is used, so that between one-quarter and three-quarters of all activities are in metric. There is a trend toward increasing use of the metric system. As international metric usage trends upward and international trade grows, there is more U.S. usage of metric units, thereby increasing involvement in dual dimensioning. More and more statistics showing international comparisons and world or regional totals are being published using metric units. Foreign markets and consumers are important to U.S. agriculture.

Up to the present time, the impact on USDA's international affairs responsibilities of the increasing worldwide and domestic metric usage has been *trivial* on the classification scale. U.S. exporters need to convert quotations and to keep figures on a dual basis. There is more relabeling or dual labeling of exported and imported products. There has been little change in trading practices.

Future Impacts of Metrication. If there is no planned national action, the USDA respondents believe that there will be a slow rate of increase in metric usage in the United States. Greater volumes of international trade and increasing worldwide use of the metric system will simplify the problems of conversion, negotiation, recordkeeping, and meeting standards. This suggests a gradual intensification of difficulties for the Department in performing its mission. However, the intensity of impact is mostly classed in the *trivial* category.

The respondents were asked what would be the effects on the USDA's international affairs responsibilities of a nationally planned program to increase the use of the metric system. The Department feels that a 10-year period would be much too long, with regard to international affairs, because it would prolong the agony of a dual system with all of its problems. The optimum period would be 1 or 2 years since this period would lead to a cheaper, more effective changeover with fewer problems and more benefits than the 10-year transition period would.

The respondents are not aware of any good numerical indicators which could be used as measures of the impact of metrication on their international affairs responsibilities. In some cases, changes in export statistics on specified commodities and packaging might be partial indicators. There have been instances where a U.S. product was unacceptable to a foreign country because it was, for example, packaged in customary-sized rather than metric-sized packages.

Adoption of metric measurement units (and/or standards) would improve the Department's effectiveness within its international affairs responsibilities. Adoption would allow all U.S. traders, shippers, etc. to discontinue use of customary weights and measures and go entirely to the metric system. There would consequently be lower costs and fewer errors.

What Action Should Be Taken? The respondents believe that the U.S. Government should initiate action to convert and lead the country. They believe that industry would readily follow, especially with regard to bulk measurements. To facilitate comparisons and bargaining with other countries, U.S. specific import tariff rates and import quotas (copra, sugar, meat, etc.) should be expressed in metric units.

DEPARTMENT OF COMMERCE

Department of Commerce Liaison Representative:

Paul T. O'Day, Executive Assistant to the Secretary

The mission of the Department of Commerce is to promote the full development of the economic and technological resources of the United States. It does this through programs and actions which encourage and assist States, regions, communities, industries, and firms toward economic progress. Specific programs carried out include the collection, analysis, and dissemination of demographic, economic, business, scientific, and environmental information; the promotion of exports and increased travel to the U.S.; and the provision of financial and technical assistance to regions and communities with lagging economies.

Other important functions include promoting policies for strengthening the international economic position of the U.S. and the healthy growth of the private economy; providing incentives for private commercial investment in new technology; assuring maximum use, growth, and transfer of the Nation's scientific and technical resources; fostering development of the American merchant marine; and coordinating Federal programs in the field of minority business enterprise.

Commerce also administers the national patent and trademark systems, provides weather and other environmental services, exercises controls over the export of strategic materials, and carries out materials priorities and industrial mobilization programs. A further important aspect of the mission is the conduct of scientific research and services in physical measurement standards, in engineering, product and commodity standards, in extending knowledge of the oceans, earth, and atmosphere, and in advancing selected fields of technology.

Following are subchapters which discuss the impacts of metrication on the following organizations within the Department of Commerce:

1. Environmental Science Services Administration
2. Bureau of International Commerce
3. Maritime Administration
4. Patent Office
5. National Bureau of Standards
6. U.S. Travel Service
7. Office of Product Standards
8. Office of Telecommunications

ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION (ESSA)

Liaison Representative:

Morton J. Rubin, Chief, Office of Special Studies

Respondents — Internal Operations:

1. Environmental Data Service
2. Weather Bureau
3. National Environmental Satellite Center
4. Research Laboratories
5. Coast and Geodetic Survey

Respondents — Science and Technology Area of National Responsibility:

1. Administrator, Environmental Science Services Administration
2. Chief, Office of Special Studies

Respondents — Environmental Pollution Control Area of National Responsibility:

1. Administrator, Environmental Science Services Administration
2. Chief, Office of Special Studies

1. Mission of the Environmental Science Services Administration (ESSA).[1] The mission of ESSA is to describe, understand, and predict the state of the oceans, the state of the lower and upper atmosphere, and the size and shape of the earth, in order to further the safety and welfare of the public, improve the Nation's economy, and assist those Federal departments concerned with the national defense, the exploration of outer space, and the management of natural resources.

2. Extent of Metric Usage in the Environmental Science Services Administration (ESSA). Currently, metric units of measurement are used by all five ESSA respondents; three respondents use metric engineering standards.

The Environmental Data Service uses metric units in its physical science activities and in its applications of foreign data.

The Weather Bureau uses metric units in its meteorological activities (equipment development, weather analysis and forecasting, international standards for facsimile, observations and data, meteorological measurements, air pollution meteorology, air analyses, and evaporation data); metric engineering standards are used in measuring solar winds aloft, solar radiation, temperature, and atmospheric conditions.

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[1] Some complications have arisen since the undertaking of this Study. The name "Environmental Science Services Administration" (ESSA) has been dropped entirely and its activities, among others, have been included in the newly-formed National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce. NOAA includes ESSA, most of the Bureau of Commercial Fisheries from the Department of the Interior, the National Oceanographic Data Center (Navy), the National Oceanographic Instrumentation Center (Navy), and several other units of the Executive Branch. The information for this report (and for the report on the Department of the Interior) was obtained before the formation of NOAA.

The National Environmental Satellite Center uses metric units in satellite command and control operations, in many meteorological variables, and in specifications of instrument performance; metric engineering standards are used in specifications for environmental testing of instruments and in certain meteorological activities.

The Coast and Geodetic Survey uses metric units in all earth science disciplines.

The Research Laboratories of ESSA use metric units in nearly all their scientific measurements and in certain scientific journals; metric engineering standards are used in chemical analyses.

All five ESSA respondents mention specific advantages of their current metric usage. International cooperation, use of the metric system by scientific activities, and operational improvement are the most frequently mentioned advantages. Three respondents (the Environmental Data Service, the Weather Bureau, and the Research Laboratories) mention disadvantages. The need to convert historical data and minor awkwardness resulting from the use of two measurement systems within ESSA are the most frequently mentioned disadvantages. The National Environmental Satellite Center and the Research Laboratories judge the advantages of their current metric usage to outweigh the disadvantages. The Environmental Data Service cannot use the metric system advantageously in its engineering work. The Weather Bureau experiences some confusion which arises from the need to relate two measurement systems continuously.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Under this assumption, two ESSA respondents anticipate increased use of metric units and engineering standards; one respondent anticipates increased use of metric units; one respondent (Environmental Data Service) anticipates no changes in its use of metric units or engineering standards; and one respondent (Research Laboratories) is unable to make an estimate.

The Weather Bureau foresees a gradual increase in its use of metric units and engineering standards. The National Environmental Satellite Center plans to change its remaining non-metric usages as rapidly as permitted by the parties with whom the Center interfaces (this transition is expected to be very slow). The Coast and Geodetic Survey plans to express tidal and nautical chart data in metric units. These changes toward metrication will be brought about by a desire to improve quality or performance, changes made by ESSA's suppliers, increasing domestic and international use of the metric system, and efforts to realize savings of time and dollars.

ESSA's annual added internal costs (some of these costs are "one-time only costs" to modify equipment) and savings are both expected to be less than 1 percent as a result of these changes. Cost increases for the Weather Bureau will result from revision of manuals, error corrections, and conversion of a large amount of specialized engineering hardware. The National Environmental Satellite Center expects slight programming costs for the conversion of automatic data processing routines, but the Center thinks these will be outweighed by savings resulting from increased convenience. The Coast and Geodetic Survey anticipates costs for the conversion of equipment and data banks.

Only the Weather Bureau foresees problems of transition. These include resistance to change by personnel, revision of manuals, personnel retraining, interfacing compatibility of equipment, and communication with the general public.

If no changes toward metrication are made by ESSA, three respondents (the Environmental Data Service, the Weather Bureau, and the Research Laboratories) anticipate problems because of the increasing metric usage outside ESSA. The most frequently mentioned problems are dual dimensioning, training, waste, and international cooperation.

4. Anticipated Impact Under a Nationally Coordinated Program to Increase Use of Metric Units (Assumption II). Under this assumption, ESSA expects a less than 1 percent increase in its internal costs during the transition period. Costs during the transition are estimated to total approximately $570,000 annually.

The Environmental Data Service anticipates annual cost increases of $40,000 for data handling. The Weather Bureau anticipates increased annual costs of approximately $9,000 for weather forecasts, warnings, and analysis; costs for conversion of the Weather Bureau's publications are expected to total $20,000 annually. The National Environmental Satellite Center expects very small added costs and internal savings. The Coast and Geodetic Survey anticipates annual added costs of $500,000 for conversion of its marine charting activities. The Research Laboratories expect no changes in their internal savings or added costs.

During the post-transition period, ESSA anticipates a less than 1 percent increase in its annual internal costs.

The Environmental Data Service expects an annual cost increase of $30,000 for data handiing. The Weather Bureau anticipates a less than 1 percent increase in its annual costs. The National Environmental Satellite Center and the Coast and Geodetic Survey anticipate a less than 1 percent internal savings or added costs. The Research Laboratories expect no changes in their internal savings or added costs.

All five ESSA respondents mention specific long-term advantages which would result from the adoption of metric units of measurement; two respondents (the Environmental Data Service and the Weather Bureau) mention a disadvantage. Improvement of international communications and operational improvement are the most frequently mentioned advantages. Cost increase is the only disadvantage mentioned.

To implement a transition to metric units of measurement, the Environmental Data Service would have to redesign computer punched cards, computer programs, publication formats, and indexes to archives. The Weather Bureau would have to train personnel in metric usage and revise lists, tables, and publications. The remaining three respondents (the National Environmental Satellite Center, the Coast and Geodetic Survey, and the Research

Laboratories) would have to do nothing beyond taking appropriate administrative action.

If there were a planned national effort to adopt metric units of measurement, two respondents foresee problems of transition. The Environmental Data Service notes that certification of weather records in metric from observations taken under the English system would introduce conversion errors in court documents. The Service also expects problems in the education and training of cooperative observers drawn from the general public. The Weather Bureau anticipates problems in operations, maintenance and equipment, education and training of personnel, coordination with FAA requirements, and in dual logistics support. Altimeters would also have to be redesigned.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Measurement (Assumption III). Under this assumption, ESSA expects a 1 to 5 percent increase in its annual costs during the transition period. Costs during the transition are estimated to total approximately $730,000 annually or about $160,000 more than the total under the prior assumption.

The Environmental Data Service anticipates annual cost increases (in addition to those cited under Assumption II) of $30,000 for applications of data and $5,000 for conversion of data processing equipment. The Weather Bureau anticipates an annual cost increase (in addition to that cited under Assumption II) of approximately $125,000 ($5,000 for weather forecasts, warnings, and analysis; $15,000 for weather publications; $100,000 for engineering; and $5,000 for hydrology).

During the post-transition period, ESSA expects a less than 1 percent increase in its costs. Costs during the post-transition period are expected to total approximately $38,000 annually.

The Environmental Data Service anticipates annual added costs of $13,000 ($3,000 for equipment; and $10,000 for application of data). The Weather Bureau expects a $25,000 increase in its annual costs for its engineering activities. The National Environmental Satellite Center expects a less than 1 percent internal savings or added cost. The Coast and Geodetic Survey and the Research Laboratories foresee no changes in their internal savings or added costs.

Advantages and disadvantages of metrication under this assumption are essentially the same as those under Assumption II. Steps for the implementation of the metric system are also essentially the same as those under Assumption II with the exception of the Weather Bureau. If there were a nationally coordinated program to increase use of metric engineering standards as well as metric units of measurement, the Weather Bureau would have to modify a certain amount of its instruments and engineering equipment in addition to training its personnel in metric usage and revising certain lists, tables, and publications. Consequently, during the transition period the Weather Bureau would face problems in maintenance and equipment.

6. Conclusion. The Weather Bureau, the National Environmental Satellite Center, and the Coast and Geodetic Survey recommend a nationally coordinated program to increase use of metric units and engineering standards.

For the Weather Bureau, the greatest advantage of metrication lies in the fact that after the transition the Bureau would be in concert with the international community and would, therefore, be in a better position to cooperate with them. The Environmental Data Service does not recommend a national program of metrication since the decimal advantage represented by the metric system means little in computer activities. The Research Laboratories make no recommendations since they already use metric units extensively in their work and are only minimally involved with engineering standards.

The consensus of ESSA subdivisions favors a 10-year transition period for metrication. However, a transition period of 5 years would be satisfactory for some ESSA activities (e.g., satellite observations) which currently produce some data in metric units.

Impacts of Metrication on U.S. Science and Technology

Present Metric Usage. ESSA estimates that the metric system is used in over three-quarters of all activities in U.S. science and in between one-quarter and three-quarters of all activities in U.S. technology. ESSA observes that U.S. technology is gradually adopting the metric units which have been used by U.S. science for years. Increasing domestic and international use of the metric system is estimated by ESSA to have had a *negligible*[2] impact on U.S. science and a *trivial* impact on U.S. technology. Metric units have long been used in most areas of science while technological areas have had to adopt new scales on equipment as a result of increasing metrication.

Future Impacts of Metrication. Assuming no concerted national action to promote increased use of the metric system, ESSA estimates that increasing domestic and international use of the metric system should have no effect on U.S. scientific activities. In the area of technology the effect will be the perpetuation of the present inconvenience of having to maintain "dual" measurement systems.

If there were a nationally planned program to increase use of the metric system over a 10-year period, ESSA estimates that U.S. science would be unaffected since it has already substantially adopted metric units. Communication between science and technology should be improved. Since a single set of units would be advantageous for U.S. technology in the long run, a nationally planned program of metrication would appear to have an advantage over the present evolutionary trend toward metric units which often requires use of two systems of units.

ESSA estimates that increasing domestic and international use of the metric system has had a slightly favorable impact on its ability to perform its mission with respect to U.S. science and technology. Adoption of the metric system should slightly improve ESSA's effectiveness within U.S. science and technology in the long run. ESSA's effectiveness within U.S. technology might be slightly reduced during the transition period.

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[2] See "Classification of Intensities of Impact" scale on p. 79.

What Action Should Be Taken? ESSA recommends a nationally coordinated program to convert to the metric system.

Impacts of Metrication on Environmental Pollution Control

Present Metric Usage. The metric system is used in between one-quarter and three-quarters of all work activities in the environmental pollution control field with which ESSA is concerned. There does not appear to be a trend toward greater metric usage.

Thus far, the impact on ESSA's pollution control responsibilities has been *trivial.* Hydrologic forecasts have used customary units to a large extent. To meet the needs of some users, some data has been provided in dual units—customary and metric. Tide predictions have been given in customary and metric units.

Future Impacts of Metrication. Assuming *no* concerted national action to increase the use of the metric system in the United States, the present inconveniences of a dual system will continue.

On the other hand, a concerted national effort to increase metric usage would eliminate the present unsatisfactory dual system of units. Even though there would be some difficulties during the transition period, metrication would be advantageous in the long run. Instrument makers, for example, would no longer have to make one instrument for the domestic market and another for the foreign market. Metrication in the United States would improve the ability of ESSA in performing its mission with respect to its environmental pollution control responsibilities. The impact on ESSA's ability to perform its mission would be *trivial.*

What Action Should Be Taken? ESSA believes that metrication should be encouraged by mounting a national program to adopt the metric system.

BUREAU OF INTERNATIONAL COMMERCE (BIC)

Liaison Representative:

M. van Gessel, Deputy Director, Bureau of International Commerce

Respondents—International Trade Area of National Responsibility:

1. Deputy Director, Bureau of International Commerce
2. Staff Assistant to the Director, Bureau of International Commerce

1. Mission of the Bureau of International Commerce. The prime objective of the BIC is to increase U.S. exports. This contributes to the Nation's economic growth and helps to reduce the deficit in the U.S. balance of payments. To carry out this objective, BIC: (1) provides services and information for American businessmen to help them trade abroad; (2) operates overseas trade centers, sends trade missions abroad, stages commercial exhibitions at international trade fairs, and provides other marketing services to promote the sale of U.S. goods abroad; (3) works with other Governmental agencies and international organizations to improve conditions for international trade and investment; (4) presents the views of traders and investors in governmental councils; and (5) works out policies and procedures to make doing business abroad simpler and more profitable.

The BIC also administers the Export Administration Act to prevent the export of strategic and other U.S. materials because of national security, foreign policy, and short supply. In addition, the BIC administers the China Trade Act to promote U.S. exports to Hong Kong and Taiwan.

Impacts of Metrication on International Trade

Present Metric Usage. The BIC estimates that the metric system is used in less than one-quarter of U.S. international trade activities. Metric usage in international trade is increasing. More nations (e.g., Britain, Australia) are converting to the metric system. Metric units are increasingly used in the establishment of international standards which affect international trade. Thus far, the BIC estimates that this increasing domestic and international use of the metric system has had a *trivial*[3] impact on the Nation's international trade activities. The BIC notes that the U.S. is usually able to provide equipment which is compatible with the metric system when this is required as a condition for sales; on the other hand, countries wishing to sell on the U.S. market are usually able to provide non-metric equipment when necessary. Consequently, the impact of increased metrication on U.S. trade has been slight.

Future Impacts of Metrication. BIC estimates that the competitive position of the U.S. in world trade would probably suffer if the rest of the world increased its use of the metric system while the U.S. made no national effort to do so. This result would stem from a decline in markets for non-metric goods and from increased competition from metric system nations for markets in metric system countries.

A national program to increase use of the metric system over a 10-year period would probably not have a significant net impact on U.S. trade. The BIC thinks such a program would tend to favor the use of metric equipment on new capital investments and might thereby generate increased imports on this type of equipment until domestic production of metric equipment catches up. On the other hand, individual exporters could be expected to continue their exports of non-metric goods for as long as they could do so. The U.S. is able to export non-metric goods now and BIC estimates that a 10-year transition period would, in most cases, allow the conversion process to occur by the replacement of obsolete production equipment with new equipment to produce metric goods and would allow individual firms to effect the change in response to their competitive situation in the world. In the long run, the program would probably enhance the competitive position of the U.S. in world trade.

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[3] See "Classification of Intensities of Impact" on scale on p. 79.

The optimum period for the transition would depend on the average depreciation period of production equipment for exports. Since the exports most affected by the change would be machine tools, BIC believes that the optimum period would probably be between 10 to 20 years, the average depreciation period for machine tools. The longer period would probably be desirable, since it would give individual exporting firms greater flexibility. Since the exporting firm would respond to the program in terms of its individual situation (i.e., productive life of its equipment and competitive pressures abroad), there is no single optimum period. However, the longer the transition period, the smaller the immediate impact on imports would be.

The effects of converting to the metric system would be reflected in the balance of trade accounts, but the BIC notes that these would tend to cancel each other and would be obscured by other factors operating on the accounts. Thus, the BIC finds it nearly impossible to quantify the impact of metrication accurately.

The BIC estimates that increasing domestic and international use of the metric system has had a *trivial* impact on its ability to perform its mission, the promotion of U.S. exports. The BIC believes that adoption of the metric system would improve its effectiveness in promoting U.S. exports since such a transition would facilitate U.S. penetration of foreign markets by bringing U.S. measurement systems into line with the rest of the world. It is not possible for the BIC to accurately quantify the effect, but due to other factors affecting the expansion of U.S. exports, the effect would probably not be very significant.

What Action Should Be Taken? The BIC recommends that the United States support a national plan to convert to the metric system. There might be some adverse effects on the U.S. balance of trade in the short run, but in the long run such a change would be beneficial.

MARITIME ADMINISTRATION (MARAD)

Liaison Representative:

Paul E. Speicher, Jr., Office of Ship Construction

Respondents — Internal Operations:

1. Office of Administrative Services
2. Office of Data Systems
3. Office of Research and Development
4. Office of Ship Construction
5. Office of Ship Operations
6. Division of Ports, Office of Ports and Intermodal Systems
7. Division of Transport Systems, Office of Ports and Intermodal Systems
8. Office of the Assistant Administrator for Maritime Aids
9. Office of Policy and Plans

Respondents—Federal Assistance to the Merchant Marine Area of National Responsibility:

1. Administrator, Maritime Administration
2. Assistant Administrator for Operations
3. Chief, Office of Ship Operations
4. Chief, Office of Ports and Intermodal Systems
5. Deputy Chief, Office of Ship Construction

1. Mission of the Maritime Administration. The Maritime Administration administers programs authorized by the Merchant Marine Act, 1936, as amended, and related shipping statutes to aid in the development, promotion, and operation of the U.S. merchant marine, so that it will be (a) adequate to carry the Nation's domestic waterborne commerce and a substantial portion of its foreign commerce during peacetime; (b) capable of serving as a naval and military auxiliary in time of war or national emergency; (c) owned and operated under U.S. flag by citizens of the United States, so far as may be practicable; and (d) composed of the best equipped, safest, and most suitable types of ships manned by trained and efficient citizen personnel.

2. Extent of Present Metric Usage in MARAD. Currently, metric units and engineering standards are used by three of the nine responding groups in MARAD. The Office of Research and Development uses metric units in the areas of nuclear reactor engineering, electricity, and illumination; metric engineering standards are used in radiation and electrical work. The Office of Ship Construction uses metric units and engineering standards in marine electrical and electronic engineering, evaluation of foreign ship components, and formulation of international rules for ships. The Division of Transport Systems in the Office of Ports and Intermodal Systems uses metric units and engineering standards in the design and construction of intermodal containers and container handling equipment. Facilitated international cooperation, use of SI by related scientific activities, and the increased capability of evaluating foreign competition are the reasons for metric usage. Lack of familiarization with the metric system on the behalf of some personnel is the most frequently mentioned disadvantage of current metric usage.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Two of the nine MARAD respondents anticipate increased use of metric units and engineering standards under this assumption. Both respondents of the Office of Ports and Intermodal Systems (the Division of Ports and the Division of Transport Systems) anticipate increased metric usage due to international agreements and increasing international metric usage. Changes in added costs or savings due to increased metric usage are expected to be minimal. Orientation of personnel in metric usage is the only problem of transition anticipated.

Eight of the nine MARAD respondents anticipate problems if they do not make changes toward metrication. The most common anticipated problems are increased conversions, hindered international cooperation, and increased interfacing caused by the increasing worldwide metric usage.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption, three MARAD respondents anticipate increased costs during the transition period and six respondents anticipate no changes in their internal costs during the transition period. The Office of Ship Construction, the Office of Ship Operations, and the Office of Administrative Services expect a very small (less than 1 percent) increase in their annual added costs during the transition period. The Office of Ship Construction estimates that this would amount to annual added costs of $3,000 in the area of engineering data activities. The Office of Ship Operations expects an annual cost increase of about $1,000. The Office of Administrative Services expects an annual average added cost of about $2,000; actually most of the total transition cost would occur in the first 6 months for retraining of carpenters.

During the post-transition period, the Office of Ship Construction and Office of Ship Operations anticipate changes in their internal costs under this assumption and the other seven respondents anticipate no changes in their costs. The Office of Ship Construction ($300 savings for engineering data) and the Office of Ship Operations (insignificant savings) expect a less than 1 percent savings during the post-transition period under this assumption.

Thus, MARAD anticipates a $6,000 annual added cost during transition and an annual savings of several hundred dollars after the transition.

Eight of the nine MARAD respondents mention long-term advantages which would result from the adoption of metric units of measurement; two respondents cite disadvantages. Improvement of international communications is the most frequently mentioned advantage; minor cost increase is the disadvantage mentioned.

If there were a planned national effort to adopt metric units of measurement, five MARAD respondents would face problems of transition. The impact of such a transition on MARAD would be primarily one of educating employees to think in metric terms and converting data banks of design information to the metric system.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Measurement (Assumption III). Under this assumption, the MARAD respondents except for the Office of Ship Operations, anticipate the same changes in their internal costs during the transition and post-transition periods as under the prior assumption. The Office of Ship Operations expects an annual increase of $2,000 under Assumption III. The same long-term advantages and disadvantages are also anticipated.

If there were a planned national effort to adopt metric engineering standards as well as metric units of measurement, the conversion of ship standards and specifications could result in a moderate to substantial impact unless a practical approach were taken. Assuming a 25-year life for a ship, there would inevitably be some ships whose life would span the entire 10-year contemplated transition period. These ships should continue to be maintained throughout their entire life span under the system in which they were constructed.

6. Conclusion. Overall, MARAD favors a clear and positive U.S. Government policy toward metrication with phases or stages delineated and scheduled over a transition period until complete conversion to SI is attained. MARAD thinks that conversion to the metric system must come eventually and the sooner a time phased change to the metric system is initiated, the less expensive it will be in the long-run. As time passes, the increased growth of complex, technical systems makes transition more difficult. Consequently, MARAD has no objections to adoption of the metric system over a 10-year period.

Five of the nine MARAD respondents regard a 10-year period for transition to the metric system as satisfactory. Three respondents would be unaffected by any transition period. The Office of Ship Operations thinks the length of the transition period should be determined on a selected basis by the life span of a ship, approximately 25 years (as noted above). This Office notes for instance that inch-pound standards would probably be maintained for a vessel's life regardless of the length of a planned phase-out period.

Impacts of Metrication on Federal Assistance to The Merchant Marine

Present Metric Usage. The metric system is used in less than one-quarter of all Federal programs of assistance to the U.S. Merchant Marine. The Maritime Administration notes a trend toward increased metric usage in this area; the rest of the world's merchant marine is moving toward complete adoption of the metric system. To date, MARAD estimates that increasing domestic and international use of the metric system has had a *trivial*[4] impact on Federal programs of assistance to the U.S. Merchant Marine; the need for maintaining dual records has increased.

Future Impacts of Metrication. Assuming that the Federal government takes no action to promote increased use of the metric system, MARAD estimates that the need to maintain dual records will continue and that costs for these records will probably increase.

In the event of a nationally planned program to increase use of the metric system over a 10-year period, MARAD estimates that added costs of dual recording would continue during the transition period. After the transition, there would be some cost savings.

If the transition period for metrication were between 10 and 20 years, MARAD estimates that added costs would continue over a longer period of time because of the longer transition. After this longer transition period, savings would be the same as after the transition of 10 years.

The Maritime Administration estimates that increasing domestic and international use of the metric system has had a *trivial* impact on its ability to carry out programs of Federal assistance to the U.S. Merchant Marine. There is a need to maintain dual records and increased metric usage has placed MARAD at some disadvantage in verbal and written communications. The Maritime Administration thinks that adoption of the metric system would improve its effectiveness in administering programs of Federal assistance to the U.S. Merchant Marine. In the long-run, such a conversion would eliminate the need for dual records. Technical discussion and understanding would be facilitated and, by eliminating the confusion inherent with the "feet, inches, and eighths" terminology currently used in the ship hull engineering, the use of the metric system would simplify existing procedures and result in fewer errors.

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[4] See "Classification of Intensities of Impact" scale on p. 79.

What Action Should Be Taken? Overall, MARAD favors a clear and positive U.S. Government policy toward metrication with phases or stages delineated and scheduled over a transition period until complete conversion to SI is attained.

PATENT OFFICE

Liaison Representative:

George Hyman, Jr., Director, Office of Examining and Documentation Control

Respondents — Internal Operations:

1. Office of Appeals, Legislation and Trademarks
2. Office of Research and Development
3. Patent and Interference Examining Areas
4. Office of Administration

1. Mission of the Patent Office. The Patent Office examines applications for patents to ascertain if the applicants are entitled to patents under the law, and grants the patents when they are so entitled; it publishes and disseminates patented matter, records the assignment of patents, maintains a Search Center consisting of U.S. patents, foreign patents, and general reference literature for public use, and supplies copies of patents and official records of the Patent Office. Similar functions are performed in carrying out the statutory provisions for the registration of trademarks.

2. Present Metric Usage. Three of the four respondents now use the metric system: Patent and Interference Examining; Appeals, Legislation, and Trademarks; and Research and Development. Only the area of Administration indicates no present use of either metric measurement units or metric engineering standards. The manner in which and the extent to which metric measurement units and engineering standards are used in these areas vary considerably — from direct and extensive application of the metric system (in the total microfilm system) to indirect, incidental and minimal use in functions that are purely mental processes (in the examination and evaluation of technical disclosures in patent applications).

Within the Patent and Interference Examining areas, the metric system is used in specialized hardware, such as patent file shoe drawers and microfilm-aperture card search readers. In the Administrative area, the metric system is used in some equipment, supplies, forms, and automatic data processing equipment and materials. The Appeals, Legislation and

Trademarks area uses metric especially for international matters. The Research and Development area uses metric in the total microfilm system, ICIREPAT programs, international patent exchanges, search readers, printing of patents, and the machine readable information areas.

It must be noted, however, that none of the Patent Office areas place any definite reliance upon any system as such. The Patent Office, as an agency, almost exclusively, uses standardized equipment and supplies produced by others. Moreover, it has no formal responsibility nor direct functions related to the setting of standards. The Patent Offices' "products" are primarily intangibles: legal protection for inventions, and encouragement for scientific and economic advancement. Microfilm and paper copy are only documentation means and communications media for this legal protection. Of course, microfilm happens to be "in the metric system" and is an important aspect of the Office's file maintenance. However, the major portion of Office activity, which is centered around the examination of patent applications, is involved with measurement systems only when it is necessary to make conversions from the English system to the metric system (or vice versa). These conversions are required in order to evaluate and compare measurements present in related search reference material which includes, not only U.S. patents, but also foreign patents as well as other non-patent literature (foreign applications, periodicals, books, microfilm, etc.).

In all Patent Office uses of the metric system, regardless of the extent of use, there are recognized advantages which are mainly afforded by standardization and thus compatibility, especially with respect to its international cooperation programs. No significant disadvantages are identified.

Therefore, the extent of present metric usage in the Patent Office may be rated minimal, and for the most part incidental, except in one specific area (microfilm). There seems to be no detectable trend in metric usage insofar as the Patent Office is concerned.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). There is unanimous indication that the Patent Office will probably continue to function as it now does with respect to the use of measurement systems, i.e., that there will be no direct attempt to metricate on certain problems under Assumption I and its predicted position thereunder, the problems are relatively minor ones involved in interfacing and dual dimensioning. These problems are ones it now faces and operates under; however, it is suspected that international pressures may intensify the Office's present concerns and actions.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Generally, there is no expectation of internal savings or added costs resulting from this assumption. Only one area, the Examining Corps, is able to estimate any savings – and these are of a very inconsequential amount (about $500.00 per year during the transition period). These savings would be due to the decreased need of conversion of measurement units while searching patent application disclosures.

Most all of the Patent Office areas recognize long-term advantages of metrication. Again, however, they are intangibles and not powerfully substantial advantages. Of course, the Office recognizes that wherever there is change or conversion to a new system there may be certain costs incurred; nevertheless, there is indication that the advantages would outweigh the disadvantages by providing the opportunity to increase compatibility and standardization on an international level.

Any changes required in conversion would probably be minor changes involved in education and reorientation, not legal matters. Thus, the timing for the conversion would be immaterial to Patent Office internal concerns.

5. Anticipated Impact Under a Nationally Coordinated Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Measurement (Assumption III). The impacts under this assumption are identical to those under the prior assumption.

6. Conclusion. The Patent Office is in favor of metrication in both measurement units and engineering standards.

The following is suggested as concerted action toward metrication: (1) adopt a uniform target date for conversion; (2) convert (in total) instructional media at all levels; (3) conduct public and internal awareness programs in manufacturing, trade, and professional associations; (4) establish a tax incentive or some other means of financial assistance.

In view of the unique mission of the Patent Office and its functions, the impact of metrication would be felt only in secondary and specific areas. Therefore, the Patent Office would encourage metrication on a national level and cooperate fully to implement the transition; however, its concerns are not strong enough to cause this agency to take an active position of leadership toward metrication.

NATIONAL BUREAU OF STANDARDS (NBS)

Liaison Representative:

Chester H. Page, Chief, Electricity Division

Respondents — Internal Operations:

A. Institute for Materials Research

1. Director's Office, Institute for Materials Research
2. Physical Chemistry Division
3. Polymers Division
4. Inorganic Materials Division
5. Analytical Chemistry Division
6. Office of Standard Reference Materials
7. Metallurgy Division

B. Office of the Associate Director for Information Programs

1. Office of Standard Reference Data

C. Institute for Applied Technology

1. Office of Weights and Measures
2. Office of Engineering Standards Services
3. Building Research Division
4. Electronic Technology Division
5. Product Evaluation Division

D. Center for Radiation Research

1. Applied Radiation Division
2. Nuclear Radiation Division
3. Reactor Radiation Division

E. Institute for Basic Standards

1. Metrology Division
2. Atomic and Molecular Physics Division
3. Mechanics Division
4. Cryogenics Division
5. Radio Standards Physics Division
6. Radio Standards Engineering Division
7. Electricity Division
8. Heat Division

Respondent — The National Measurement System Area of National Responsibility:

1. Office of the Director

1. Mission of the National Bureau of Standards (NBS). NBS is a principal focal point in the Federal Government for strengthening and advancing the nation's science and technology and facilitating their effective application for public benefit. To this end the Bureau conducts research and provides central national services in four broad categories. These are: (1) promoting accurate, meaningful and compatible measurements for science and technology, (2) promoting more effective use of science and technology for industry and government, (3) promoting strength in the economy and equity for buyer and seller in trade, and (4) providing standards and test methods for protection of the public from specified hazards. Finally, the Bureau provides technical information services in support of these goals.

2. Extent of Present Metric Usage. Virtually all NBS programs (expect the Administrative divisions) make significant use of the metric system in their activities because most of the people dealing with most NBS divisions operate largely on SI measurements. In fact, NBS policy requires that the SI (International System) units as adopted by the General Conference on Weights and Measures be used in all official writing except where their use would obviously impair communication or reduce the usefulness of a report to the primary recipients. This means that in purely scientific papers, NBS programs express their results and data in SI units or in units approved for use with the SI. Values in other units are added in parentheses when this improves communication between the NBS activity and its constituents.

In technological reports, on the other hand, the results and the data are expressed in the units customarily used in the relevant field of technology, with the SI equivalents added in parentheses. For example, in reports intended primarily for the building industry, customary units are usually used as the primary units of communication. NBS programs are urged, however, to use the SI as soon as their fields of technology have reached the point of SI usage that will permit efficient communication.

There are some disadvantages to the present NBS metric usage: American industry and engineers usually prefer customary units, and some personnel are not familiar with the metric system. In general, however, NBS divisions report that advantages of their current usage outweigh disadvantages.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Most NBS Divisions foresee increasing metric usage in their activities, even in the absence of a national metrication program. Such changes would cause few significant cost impacts and no serious problems. Some instruments and equipment will need replacement and some data and codes will need revision. In the absence of such increased internal metric usage there will be increasing difficulties of dual dimensioning, conversions, and interfacing because of increased metric usage among the constituents of NBS programs.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Units of Measurement (Assumption II). If there were a planned national effort to convert to metric language (but not hardware) usage, virtually all divisions in NBS believe that the advantages of metrication would outweigh the disadvantages. Compatibility of units in international communication, facilitated promotion of U.S. standards internationally, and the inherent simplicity of the metric system would be the primary advantages of metrication. There would be some increased costs—several hundred thousand dollars per year—during the transition period. Costs would be due to the revision of U.S. codes based on standard reference materials, revision of standards, purchase of some equipment and measurement adaptors, and some retraining. Expected cost impacts after the transition period would be negligible.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Measurement (Assumption III). If there were a planned national effort to convert to metric hardware as well as measurement units, the increased costs during the transition would be significantly higher than for a language-only changeover. Annual costs for conversion would range between $500,000 and $1 million. The reasons for the greater cost would be the need for purchase of metric-based equipment and instrumentation, and the significantly greater work required on the revision of standards. However, in the long run metrication of both units and hardware would be more beneficial than metrication of units only.

6. Conclusion. NBS management, reviewing the foregoing report of its operating units on the effect of metric usage on their activities, concludes that for these purposes—the provision of a central basis for the national measurement system—it is desirable to foster increased use of the International System of Units throughout science and technology. There are advantages to moving from the present dual measurement language to a single language. The SI system is intrinsically superior to the customary one for technical purposes.

On the larger issue—whether it is in the national interest to foster a general conversion to metric usage at this time—NBS defers its views pending completion of the U.S. Metric Study for which it is responsible.

Impacts of Metrication on the National Measurement System

The National Bureau of Standards provides the central basis within the United States for a complete and consistent system of physical measurement, coordinates that system with the measurement systems of other nations, and furnishes essential services leading to accurate and uniform physical measurements throughout the Nation's scientific community, industry and commerce.

Present Metric Usage. The metric system is the measurement language of U.S. science. However, technology, industry and commerce principally use customary measurements and standards. This disparity requires conversions between the two systems of measurement, which are of some consequence, since science and technology are playing an ever larger part in the affairs of our society.

Future Impacts of Metrication. If there were a coordinated national program to increase use of the metric system, benefits would result in the area of NBS's responsibility, since communication between the worlds of science, engineering and commerce would be facilitated, the number of standards in use reduced, and scientific and engineering work simplified.

In sum, adoption of the metric system would improve NBS's effectiveness in performing its mission with regard to the national measurement system, since the present need to maintain and support dual measurement systems would be eliminated.

U.S. TRAVEL SERVICE

Liaison Representative:

William Dircks, Research and Analysis Officer

Respondent—Internal Operations:

1. Office of Research and Analysis

1. Mission of the U.S. Travel Service. The mission of the U.S. Travel Service is to engage in activities for, and in conjunction with, the travel industry for the purpose of encouraging foreigners to visit the United States.

2. Effect of Metrication on the Internal Operations of the U.S. Travel Service. The only U.S. Travel Service respondent is the Office of Research and Analysis. Currently, this Office does not use metric units of measurement or metric engineering standards in any of its activities. The Office does not anticipate that it will unilaterally make any changes toward metrication in the future.

If there were a nationally coordinated program to increase use of metric units and engineering standards over a 10-year period, the Office estimates that there would be no added costs or internal savings during the transition and post-transition periods. The Office foresees no long-term advantages or disadvantages from metrication. To implement such a transition, the Office would have to do nothing beyond converting published data from miles to kilometers and this would present no difficulties. No legal or operational problems are anticipated by the Office in the event of conversion to the metric system. The Office regards a 10-year transition period for conversion as satisfactory.

3. Conclusion. The Office of Research and Analysis recommends a nationally coordinated program to increase use of metric units of measurement, but makes no recommendations concerning metric engineering standards.

OFFICE OF PRODUCT STANDARDS

Respondent—Consumer Affairs Area of National Responsibility:

1. Director, Office of Product Standards

Impact of Metrication on U.S. Consumer Affairs

Present Metric Usage. The Director estimates that the metric system is used in less than one-quarter of all U.S. consumer affairs activities. No trends in metric usage in U.S. consumer affairs are discerned. Estimated impact on this area of increasing domestic and international use of the metric system has been *moderate.*[5] Currently, the Package Proliferation Programs of the Department of Commerce suffer because of the need to retain both metric and customary can sizes.

Future Impacts of Metrication. If there is no concerted national effort to increase metric usage, increasing confusion in consumer affairs is anticipated. U.S. international trade in consumer products may suffer if the U.S. remains non-metric.

Assuming a nationally coordinated program to increase metric usage over a 10-year period, it is expected that definite advantages would be realized for U.S. consumer affairs. Metrication is expected to result in an improvement of the worldwide language of consumer comparisons with regard to quantities and weights.

The Director estimates metrication to have a moderate impact on the ability of the Department of Commerce to perform its mission with respect to consumer affairs. Adoption of the metric system would improve the effectiveness of the Department of Commerce within U.S. consumer affairs in the long-run.

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[5] See "Classification of Intensities of Impact" scale on p. 79.

What Action Should Be Taken? The Director favors implementation of a planned conversion to the metric system. In determining the length of the transition period for metrication, consideration should be given to the amount of time needed to educate the public in metric usage.

OFFICE OF TELECOMMUNICATIONS

Respondent — Internal Operations:

1. Staff Assistant, Office of Telecommunications

Respondents — Telecommunications Area of National Responsibility:

1. Staff Members, Office of Telecommunications

1. Mission of the Office of Telecommunications. The Office of Telecommunications (OT) became a primary operating unit within the Department of Commerce on September 20, 1970. One of its functions is to serve as a support group for the Office of Telecommunications Policy in the Executive Office of the President. The major constituent division of OT, the Institute for Telecommunication Science in Boulder, Colorado, serves as the central Federal agency for research on the transmission of radio waves. The Frequency Management Support Division provides centralized technical and administrative support for coordination of Federal frequency uses and assignments.

2. Present Metric Usage. The Office of Telecommunications recognizes a dualism in the use of measurement units in the telecommunications area. The sciences which underlie telecommunications use metric units, while customary units are more apparent in areas closer to application and manufacturing. It is not unusual to see equipment dimensions, for example, quoted in inches, or the distance between microwave towers quoted in miles.

Workers in the telecommunications field have adapted to this dualism, and in the absence of a careful analytic study, OT can state no significant advantage or disadvantage to its functioning in the present mixed system.

3. Anticipated Changes If There is No National Plan for Metrication (Assumption I). Under this assumption, the Office of Telecommunications anticipates increased use of metric units of measurement. In the frequency management area, miles will be expressed in meters. Records of station location will be expressed in metric units. These changes will result from spontaneously increasing domestic and international use of the metric system. Estimated one-time cost for the Office of Telecommunications will be about $20,000 for the computer cost of revising records. No problems, legal or otherwise, are foreseen.

4. Anticipated Impact Under a National Program to Increase Use of Metric Units (Assumption II). The Office of Telecommunications believes that direct costs would be no more than $20,000, or $2,000 per year. OT distinguishes between the manufacture of equipment or construction of facilities and communications itself. Considering communications alone, as a service industry together with the administrative processes necessary to maintain the services offered, OT anticipates minimal impact and minimal problems. No major retraining of personnel would be needed and no legal problems are foreseen in the event of metrication in the communications area. The Office has no information on which to base an estimate of the effect of allowing a period of longer or shorter than 10 years for metrication.

5. Anticipated Impact Under a Nationally Coordinated Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Measurement (Assumption III). The Office of Telecommunication's response under this assumption is identical to its response under the prior assumption, except that the average annual cost would total about $4,500. Some hardware would have to be changed or replaced.

6. Conclusion. The Office of Telecommunications recommends a nationally coordinated program with industry to facilitate conversion to the metric system. The Office thinks if such a program is executed with regard to metric units of measurement, conversion to metric engineering standards would follow naturally.

Impacts of Metrication on Telecommunications

Present Metric Usage. The Office of Telecommunications estimates that there is about a 70 to 80 percent use of the metric system in U.S. telecommunications. This is very much a guess, however, because the percentage depends on how the area is delineated. In manufacturing and facilities construction, the figure is much smaller. In the basic sciences related to communications, the figure is probably higher. Excluding manufacturing and construction of facilities, the estimated impact of increasing domestic and international use of the metric system is *trivial.*[6] Most communications people have operated with dual or mixed systems of units. Electrical units are metric-based already and equipment hardware (rack mountings, screws, bolts, etc.) will be changed as the Nation evolves toward metric usage. The Office sees a continuing metric trend in telecommunications. There is a growing preference for metric units in measuring distances and measuring the performance of communication equipment, by governmental agencies.

Future Impacts of Metrication. Assuming no nationally coordinated program by the Federal Government, OT thinks that retooling in the manufacture of telecommunications equipment, but little change in its use, will be required. However, more active participation in standards setting will be needed. Such changes could make U.S. telecommunications equipment more compatible with foreign-manufactured equipment.

Assuming the development of a national program to increase use of the metric system over a 10-year period, the Office of Telecommunications believes that most costs and benefits under this assumption would be tied to achieving metric standardization in dimensioning of telecommunications hardware. A 10-year period would allow a considerable amount of equipment to be retired and replaced because of obsolescence. Early in the 10-year goal period, however, the Government would need to mount a strong program to promote specifications and standards of practice.

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[6] See "Classification of Intensities of Impact" scale on p. 79.

Concerning the impact of metrication on the functioning of OT itself, the Office estimates this impact to be *trivial*. The Office believes that adoption of the metric system would somewhat improve its effectiveness in U.S. telecommunications activities. Certain mathematical computations would be simplified and the possibility of conversion errors would be eliminated.

What Action Should Be Taken? The Office of Telecommunications, though lacking a detailed analysis of all the effects, would favor a well-planned program of metrication over the next 10 to 20 years. .

DEPARTMENT OF LABOR (DOL)

Liaison Representative:

Leon Greenberg, Associate Commissioner of Labor Statistics

Respondents — Internal Operations:

1. Deputy Assistant Secretary for Administration
2. Bureau of Labor Standards
3. Bureau of Labor Statistics
4. Bureau of International Labor Affairs
5. Bureau of Apprenticeship and Training, Manpower Administration
6. U.S. Training and Employment Service, Manpower Administration

Respondents — Labor Affairs Area of National Responsibility:

1. Associate Commissioner of Labor Statistics
2. Special Assistant to Associate Commissioner of Labor Statistics

1. Mission of the Department of Labor. The mission of the DOL is to administer and enforce laws designed to advance the public interest by promoting the welfare of the wage earners of the United States, improving their working conditions, and advancing their opportunities for profitable employment.

The DOL deals with the problems of unemployment and underemployment, fosters programs of apprenticeship and training, coordinates job security activities with other Government agencies and the public, and administers programs which offer a wide range of work-experience training. The Department also directs and coordinates labor-management relations programs and activities, establishes wage and employment standards for employees producing goods for interstate commerce, and coordinates a program of international labor and manpower planning.

2. Extent of Present Metric Usage. Currently, metric units or engineering standards are used by two of the six respondents of the Department of Labor.[1]

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[1] Two of the six agencies surveyed in the Department of Labor did not fill out the questionnaire, "The Federal Government Survey: Internal Operations" since their work in no way involves use of the metric system. They did, however, make the following responses:

The Bureau of International Labor Affairs estimates that there would be gains to the United States in Moving toward metrication in view of the extensive and growing use of the metric system in other countries. To some extent, its work in the field of international trade analysis might be facilitated by metrication, but its direct interests are quite marginal.

The Office of the Assistant Secretary for Administration indicates no current use, on its part, of metric measurement units and takes a neutral position regarding U.S. adoption of the metric system. The Office foresees no benefits or disadvantages which would result from adoption or rejection of the metric system by the U.S. and judges independent action on its part to further the use of the metric system as unlikely.

The Bureau of Labor Statistics uses metric units in the expression of price statistics for items of a scientific nature (e.g., drugs, chemicals, electricity, etc.). The Bureau of Labor Standards uses metric units and engineering standards for expression of occupational health and safety standards and in engineering systems. Operational improvement, international cooperation, use of SI by scientific activities, and conformance to industry practice where the metric system is now used, are cited as the reasons for current metric usage. No disadvantages are mentioned.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). The Bureau of Labor Statistics is the only respondent to anticipate increased metric usage under this assumption. The Bureau expects increased use of metric units in its activities because its suppliers may force the change. A one-time cost increase of under 1 percent is expected.

The Bureau of Labor Standards is the only respondent which anticipates problems if DOL makes no changes toward increased metric usage. Problems of training and dual dimensioning are foreseen by the Bureau because of the evolutionary increase of metric usage in the United States and abroad.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption, the Bureau of Labor Statistics anticipates cost impacts during the transition and post-transition periods; the remaining three respondents anticipate no cost impacts during these periods.

The Bureau of Labor Statistics expects annual added costs of $8,500 or less than 1 percent during the transition period. During the post-transition, there would be no added costs or savings.

Three of the four respondents in DOL mention long-term advantages which would result from the adoption of metric units of measurement. Operational improvement, international promotion of U.S. standards, improvement of international communications, and use of a uniform, universal measurement system based on the easy-to-use decimal system are the anticipated advantages of metrication. No long-term disadvantages are foreseen.

In order to implement the transition, DOL would have to train personnel in metric usage. The Bureau of Labor Statistics would also have to revise a large number of pricing units, pricing specifications, publication tables, and some computer programs.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Measurement (Assumption III). The DOL respondents anticipate the same adjustments under this assumption as they do under the prior assumption.

6. Conclusion. Of the six respondents of DOL, three favor a nationally coordinated program of metrication (Bureau of Apprenticeship and Training in the Manpower Administration; Bureau of Labor Standards; and Bureau of International Labor Affairs). Three respondents express no opinion as to whether or not the U.S. should adopt the metric system.[2] The respondents who favor metrication point out that there would be gains to the United States in adopting the metric system, considering the extensive and growing use of the metric system in other countries. Work in the field of international trade analysis and participation in international statistical activities might be facilitated by metrication. It was also noted that standards for occupational health and safety are now expressed in metric units, and metric engineering standards and systems are used by the regulatory agencies in this area. This facilitates the work of the Bureau of Labor Standards and will also be advantageous to expanding statistical work in the safety field.

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[2] These are: Office of Systems Support in the Manpower Administration; Bureau of Labor Statistics; and Office of the Assistant Secretary for Administration.

During the program of transition itself, programs concerned with training and education, such as those conducted by the Manpower Administration, have a particular concern since teaching the metric system would be crucial to its smooth and rapid adoption. The Bureau of Apprenticeship and Training points out that concerted action should include a "planned step-by-step program over a long transition period starting with the school system."

All but one of the respondents of the Department of Labor regard a 10-year transition period for metrication as satisfactory. The Bureau of Labor Statistics recommends a transition period of 2 years duration. In the price statistics programs of this Bureau, metrication would cause an unusually large number of specification changes. If the transition takes several years for U.S. industries to absorb, then changes would be spread out and the resulting costs of conversion would be small in any one year. However, it would be advantageous to the Bureau of Labor Statistics if all of the changes in the Bureau's statistical series could be accomplished at one time. In any event, transition will require the constant attention of the Bureau's statisticians.

Impact of Metrication on Labor Affairs

Present Metric Usage. At present, the metric system is used in less than one-fourth of the Nation's labor affairs activities. The metric system is used in the area of occupational health and safety where standards are expressed in metric units. Increasing domestic and international use of the metric system has had a *negligible*[3] effect on the Nation's labor affairs and no trend toward increased metric usage is discernible.

Future Impacts of Metrication. DOL expects the field of labor affairs to experience minor costs of conversion in the statistical area if there were a nationally planned program of metrication. The advantages of such a transition, however, would outweigh the disadvantages after the transition period, especially in those manpower areas in which much international work is done.

The increasing domestic and international use of the metric system has had a *trivial* impact on the ability of the Department of Labor to perform its mission with regard to the Nation's labor affairs. Metrication has resulted in slight disruptions of certain statistics, such as industrial prices, due to changes in specifications. Adoption of the metric system might improve the effectiveness of the Department of Labor within the Nation's labor affairs because of the system's widespread usage.

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[3] See "Classification of Intensities of Impact" scale on p. 79.

What Action Should Be Taken? The Bureau of Labor Statistics favors encouragement of an orderly transition to full metrication. This would include teaching of the metric system in schools, and as needed, on the job. In the field of international trade analysis and participation in international manpower activities, including international statistics, DOL should use metric measurement units whenever possible.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE (HEW)

Liaison Representative:

Robert Cox, Office of Management Systems, Office of the Secretary

The mission of the Department of Health, Education, and Welfare (HEW) is to improve the administration of those agencies of the Federal Government whose major responsibilities are to promote the general welfare in the fields of health, education, and social security.

The following chapter discusses the impacts of metrication upon the following agencies within the Department of Health, Education, and Welfare:

1. Environmental Health Service
2. Food and Drug Administration
3. Health Services and Mental Health Administration
4. National Institutes of Health
5. Office of Education
6. Social Security Administration
7. Social and Rehabilitation Service

ENVIRONMENTAL HEALTH SERVICE

Liaison Representative:

William N. McCarthy, Jr., Division of Management Systems

Respondents — Internal Operations:

1. Director, Division of General Services, Office of the Administrator
2. Director, Bureau of Abatement and Control, National Air Pollution Control Administration
3. Director, Bureau of Criteria and Standards, National Air Pollution Control Administration
4. Director, Bureau of Engineering and Physical Sciences, National Air Pollution Control Administration
5. Bureau of Radiological Health, Environmental Control Administration
6. Office of Information, Bureau of Solid Waste Management, Environmental Control Administration.
7. Director, Office of Program Development, Bureau of Solid Waste Management, Environmental Control Administration
8. Bureau of Water Hygiene, Environmental Control Administration
9. Director, Division of Research and Development, Bureau of Solid Waste Management, Environmental Control Administration

10. Director, Division of Technical Operations, Bureau of Solid Waste Management, Environmental Control Administration
11. Director, Office of Criteria and Standards, Environmental Control Administration
12. Office of Information, Environmental Control Administration
13. Chief, Radiological Health Data and Reports Branch, Office of Information, Environmental Control Administration

Respondents — Environmental Pollution Control Area of National Responsibility:

1. Acting Assistant Administrator for Research and Development
2. Science Information Coordinator

1. Mission of the Environmental Health Service (EHS). The mission of the Environmental Control Administration (ECA), one segment of EHS, is to preserve and improve the physical environment in order to promote the health and welfare of man through programs designed to reduce levels of exposure of people to the following hazards: improper housing and living space, noise, rodents and insects, occupational and community accidents, waterborne disease, radiation, and waste accumulation.

The mission of the National Air Pollution Control Administration (NAPCA), the other segment of EHS, is to conduct a national program for the prevention and control of air pollution in order to promote the public health and welfare. It sponsors programs in federal regulatory controls, research and development activities, technical and financial assistance, and in the development of air pollution manpower resources.

2. Present Metric Usage. Currently, metric units are used by 11 of 13[1] respondents in the EHS. Metric units are used by NAPCA for air quality data. The ECA uses metric units in radiological health activities, scientific reports and articles, laboratory activities, research and development, and in field work.

Metric engineering standards are currently used by seven of the 13 EHS respondents. ECA uses metric engineering standards in radiological health activities, in published information from foreign sources, in field work, and in regulatory health protection standards. NAPCA uses metric engineering standards in test procedures.

Eleven of the 13 EHS respondents cite specific advantages of current metric usage. Two mention disadvantages. The most frequently mentioned advantages of metric usage are facilitated international cooperation, use of SI by related scientific activities, and operational improvement. Lack of familiarization with the metric system and public preference for customary units and standards are the only disadvantages cited.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Eight of the 13 EHS respondents anticipate increased use of metric units or engineering standards under this assumption. All three responding Bureaus of NAPCA (Bureau of Abatement and Control, Bureau of Criteria and Standards, and Bureau of Engineering and Physical Sciences) anticipate a complete conversion to metric units of measurement and engineering standards by January, 1973. Four respondents of ECA (Bureau of Radiological Health, Radiological Health Data and Reports Branch and the Technical Reports Branch of the Office of Information, and the Office of Information of the Bureau of Solid Waste Management) expect increased metric usage.

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[1] Office of Program Development and the Division of General Services do not use the metric system.

These changes toward metrication will be brought about primarily by increasing domestic and international use of the metric system. The Bureau of Criteria and Standards of NAPCA and the Radiological Health Data and Reports Branch and the Technical Reports Branch in the Office of Information of ECA expect a cost increase of less than 1 percent as a result of these changes. The Bureau of Engineering and Physical Sciences of NAPCA and the Office of Information of the Bureau of Solid Waste Management in ECA both anticipate a savings of under 1 percent as a result of these changes.

Five respondents of ECA anticipate problems if no changes toward metrication are made (NAPCA will have converted to the metric system by January, 1973). The most common anticipated problems deal with international cooperation and dual dimensioning, because of the increasing metric usage outside of ECA.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption, four respondents of the Environmental Health Service anticipate increased costs during the transition period, and nine respondents anticipate no cost impacts.

Two respondents anticipate cost increases of under 1 percent during the transition period as follows:

a. Bureau of Criteria and Standards—annual cost increases of $12,000 ($5,000 for education and $7,000 for conversion).
b. Division of Technical Operations—annual cost increases of $3,500 ($2,500 for data processing and $1,000 for technical assistance).

Two respondents expect annual cost increases of 1 to 5 percent during the transition period as follows:

a. Division of General Services—an annual cost increase of $2,400.
b. Bureau of Abatement and Control—an annual cost increase of $50,000 for retraining and republication.

Three responding groups expect cost savings of under 1 percent during the post-transition as follows:

a. Division of General Services—an annual savings of $400.
b. Bureau of Criteria and Standards—an annual savings of $12,000 ($5,000 for education and $7,000 for conversion).

c. Division of Technical Operations—an annual savings of $1,000 for technical assistance.

All the respondents of the Environmental Health Service mention long-term advantages which would result from the adoption of metric units of measurement; no respondents mention any disadvantages. Improvement of international communication, easier international promotion of U.S. standards, and operational improvement are the most frequently mentioned advantages.

If there were a planned national effort to adopt metric units of measurement, only one respondent (Division of General Services) would face problems. These would consist of problems in operations, maintenance and equipment, and education and training. To implement a transition to metric units, the three respondents of NAPCA would have to execute the Administration's existing policies for conversion to the metric system as planned. The other subdivisions of EHS would have to train personnel in metric usage, require contractors and grantees to utilize the metric system, revise manuals and publications, and modify computer programs.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Measurement (Assumption III). Under this assumption, four EHS respondents anticipate increased costs during the transition period, and nine respondents anticipate no cost impacts.

The Bureau of Criteria and Standards in NAPCA expects its annual costs to increase less than 1 percent during the transition period under this assumption or $34,000—$10,000 for international affairs, $15,000 for conversion, and $9,000 for education. The Division of General Services expects its annual costs to increase by $2,400 or by 1 to 5 percent during the transition period. The Bureau of Abatement and Control in NAPCA expects a 10 percent or greater increase in its annual costs or about $125,000 annually for recalibration of equipment, for purchase of new equipment, for redesigning and for retraining.

The Division of Technical Operations expects an annual cost increase of under 1 percent, or about $13,500—$10,000 for rewriting programs, $1,000 for technical assistance, and $2,500 for data processing activities.

During the post-transition period, three EHS respondents anticipate changes in their internal savings or added costs under this assumption, and 10 respondents anticipate no cost changes.

The Division of General Services in the ECA, the Bureau of Criteria and Standards, and the Division of Technical Operations expect savings of less than 1 percent during the post-transition period. The Division of General Services expects annual savings of $400. The annual savings in the Bureau of Criteria and Standards would amount to $30,000—$6,000 for international activities, $15,000 in conversion activities, and $9,000 in education activities. The annual savings in the Division of Technical Operations would amount to about $1,000 due to savings in technical assistance programs.

Nine of the respondents of the EHS cite specific long-term advantages which would result from the adoption of metric engineering standards; only one respondent mentions a disadvantage. Improvement of international communication is the most often mentioned advantage of metric engineering standards while operational impairment is the only disadvantage mentioned.

If there were a planned national effort to adopt metric engineering standards as well as metric units of measurement, only two of the 13 EHS respondents (Division of General Services and the Bureau of Abatement and Control) would face problems. These would occur in the areas of operations, laws, maintenance and equipment, and education and training. To implement a transition to metric engineering standards, the Environmental Health Service respondents would have to follow the same procedures as involved in a transition to metric units as described above under Assumption II.

6. Conclusion. Twelve of the 13 EHS respondents favor a nationally coordinated program to increase use of metric measurement units and metric engineering standards and only the respondent from the Office of Program Development makes no recommendation on this issue.

Five of the 13 EHS respondents regard a 10-year period for transition to the metric system as satisfactory. Four respondents are unable to estimate the adequacy of a 10-year transition period and four respondents recommend a transition period longer or shorter than 10 years.

The Division of General Services recommends a transition period of 15 years for metrication because it feels the education and training of personnel in metric usage may take longer than 10 years.

The Bureau of Abatement and Control in NAPCA recommends a transition period of 5 years for conversion to metric units but is uncertain with regard to engineering standards. The Bureau of Water Hygiene recommends transition periods of 5 years for conversion to metric units and 7 years for conversion to metric engineering standards because a transition period shorter than 10 years would decrease cost and disruption. The Division of Technical Operations recommends a transition period of 2-5 years duration for conversion to the metric system because it believes the metric system would be more readily adopted if no alternatives to it are left available.

Impacts of Metrication on Environmental Pollution Control

Present Metric Usage. The EHS estimates that the metric system is used in less than one-fourth of the activities in the engineering and equipment manufacturing fields concerned with pollution control and between one-quarter and three-quarters of the scientific and technical activities in the pollution control area. No trends in metric usage in the pollution control area are discerned and the EHS estimates that increasing domestic and international use of the metric system has had a *trivial*[2] impact on U.S. pollution control activities. The Service notes that research and analytical activities in pollution control are traditionally conducted in metric units and that there is little evidence of significant change in the use of metric units in the design and manufacture of pollution control equipment.

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[2] See "Classification of Intensities of Impact" scale on p. 79.

Future Impacts of Metrication. Assuming no concerted national action to promote increased use of the metric system, EHS estimates that increasing domestic and international use of the metric system will have little effect on U.S. pollution control activities.

If there were a nationally planned program to increase use of the metric system over a 10-year period, EHS estimates that there would be costs of revision for converting the designs of existing pollution control equipment to a metric basis. Problems of an adequate spare parts supply for currently operating pollution control equipment might result. However, conversion to the metric system might benefit export sales of U.S. pollution control equipment. If the transition period for metrication were longer than 10 years, but less than 20, EHS thinks that the effects of conversion would be similar to those of a 10-year transition but would be less acute.

The Environmental Health Service estimates that increasing domestic and international use of the metric system has had a *trivial* impact on its ability to perform its mission with respect to U.S. pollution control activities. The Service estimates that adoption of the metric system would have little impact on its effectiveness within pollution control activities.

What Action Should Be Taken? EHS recommends that the Federal Government encourage the metrication of U.S. industrial and engineering standards as they are revised and as new standards are developed. Cost effects should be critically evaluated on an industry by industry basis.

FOOD AND DRUG ADMINISTRATION (FDA)

Liaison Representative:

Herbert J. Harris, Division of Management Systems

Respondents—Internal Operations:

1. Division of Drug Experience, Office of Marketed Drugs
2. Scientific Coordination Staff, Assistant Commissioner for Field Coordination
3. Office of Legislative Services
4. Division of Dental and Surgical Drugs
5. Office of Associate Commissioner for Education and Information
6. Office of Associate Commissioner for Compliance
7. Facilities Management Branch, Division of General Services
8. Office of Foods and Nutritional Sciences, Bureau of Foods, Pesticides and Product Safety
9. Office of Research and Training Grants
10. Analytical Studies Branch, Division of Management Systems

11. Division of Statistics
12. Division of Veterinary New Drugs, Bureau of Veterinary Medicine

1. Mission of the Food and Drug Administration. The mission of the FDA is to protect the public health of the Nation as it may be impaired by foods, drugs, cosmetics, therapeutic devices, hazardous household substances, poisons, pesticides, food additives, flammable fabrics, and various other types of consumer products.

2. Present Metric Usage. Currently, metric units are used by nine[3] of the 12 respondents of the FDA. Metric units are used in analytical procedures for the enforcement of regulatory acts; scientific research and testing; chemical and biological analysis; and data concerning pharmaceutical products.

Metric engineering standards are used by five[4] of the 12 FDA respondents. They are used for food, pharmaceutical, and product safety standards.

Nine of the 12 FDA respondents cite specific advantages of current metric usage. No respondents mention any disadvantages. Facilitated international cooperation and use of SI by related scientific activities are the most frequently mentioned advantages of metric usage.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Only one (Office of Associate Commissioner for Compliance) of the 12 FDA respondents anticipates increased metric usage under this assumption. This Office plans to begin use of metric units in its activities because of increasing domestic and international use of the metric system. The Office is unable to estimate what changes in its costs or savings might occur.

Seven FDA respondents anticipate problems if no changes toward metrication are made; these would occur because of the increasing metric usage outside of FDA. The most common anticipated problems are dual dimensioning and international cooperation.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption, one FDA respondent anticipates internal savings or added costs during the transition period, and 11 respondents anticipate no cost changes.

The Office of Foods and Nutritional Sciences expects an annual savings of $100,000 ($20,000 for Research and Testing and $80,000 for compliance) or less than 1 percent during the transition period. This office anticipates an annual savings of $200,000 ($40,000 in research and testing activities and $160,000 for compliance activities) or less than 1 percent during the post-transition period.

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[3] These are: Scientific Coordination Staff, Office of Legislative Services, Division of Dental and Surgical Drugs, Facilities Management Branch, Office of Foods and Nutritional Sciences, Office of Research and Training Grants, Analytical Studies Branch, Division of Statistics, and Division of Veterinary New Drugs.

[4] These are: Division of Dental and Surgical Drugs, Office of Foods and Nutritional Sciences, Analytical Studies Branch, Division of Statistics, and Division of Veterinary New Drugs.

Nine of the 12 FDA respondents mention long-term advantages which would result from the adoption of metric units of measurement; two respondents mention disadvantages. Operational improvement and improvement of international communications are the most frequently mentioned advantages. Operational impairment is the only disadvantage mentioned.

If there were a planned national effort to adopt metric units of measurement, three FDA respondents (Scientific Coordination Staff, Office of Associate Commissioner for Compliance, and Office of Research and Training Grants) would face minor problems. These would entail revisions of laws and regulations that the three respondents operate under.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Measurement (Assumption III). Under this assumption, two FDA respondents anticipate savings during the transition period, and 10 respondents anticipate no cost changes.

The Office of Foods and Nutritional Sciences expects an annual savings of $60,000 ($10,000 for research and testing activities and $50,000 for compliance activities) or less than 1 percent during the transition period. The Office of the Assistant Commissioner for Field Coordination expects an annual cost increase of about $500 in order to convert some weights and thermometers.

During the post-transition period, one FDA respondent anticipates savings under this assumption, while 11 respondents anticipate no cost changes.

The Office of Foods and Nutritional Sciences anticipates an annual savings of $220,000 ($30,000 in the research and testing activities and $190,000 in compliance activities) or less than 1 percent during the post-transition period.

If there were a planned national effort to adopt metric engineering standards as well as metric units of measurement, the FDA respondents would realize the same advantages and disadvantages and face the same problems of transition as under a nationally planned program to increase use of metric units alone.

6. Conclusion. Eight[5] of the 12 FDA respondents favor a nationally coordinated program to increase use of metric units and engineering standards and four respondents make no recommendations on this issue. The respondents who favor metrication stress the roles of public education and legal action in accomplishing the transition.

Nine of the 12 FDA respondents are unable to estimate the adequacy of a 10-year transition period for metrication; two respondents regard a 10-year transition period for metrication as satisfactory; and one respondent recommends a transition period shorter than 10 years.

The Office of Foods and Nutritional Sciences recommends a transition period of 5 years for conversion to metric engineering standards because earlier adoption would simplify the promulgation of standards, and a transition shorter than 10 years under a dual system would result in some savings.

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[5] These are: Scientific Coordination Staff, Office of Legislative Services, Division of Dental and Surgical Drugs, Facilities Management Branch, Office of Foods and Nutritional Sciences, Office of Research and Training Grants, Division of Statistics, and Division of Veterinary New Drugs.

HEALTH SERVICES AND MENTAL HEALTH ADMINISTRATION (HSMHA)

Liaison Representative:

Mrs. Sonia Bergman, Office of Management Policy

Respondents — Internal Operations:

1. Office of Systems Management, Office of the Administrator
2. HSMHA Supply Service Center, Office of the Administrator
3. Office of Grants Management, Office of the Administrator
4. Office of Program Planning and Evaluation, Office of the Administrator
5. Office of Information, National Center for Health Statistics
6. Office of Administrative Management, National Center for Health Statistics
7. Office of Statistical Methods, National Center for Health Statistics
8. Division of Vital Statistics, National Center for Health Statistics
9. Division of Health Resources Statistics, National Center for Health Statistics
10. Computer Systems Branch, National Communicable Disease Center
11. Administrative Services Branch, National Communicable Disease Center
12. Engineering Services Branch, National Communicable Disease Center
13. Kansas City Laboratories, National Communicable Disease Center
14. Fort Collins Laboratories, National Communicable Disease Center
15. Phoenix Laboratories, National Communicable Disease Center
16. San Juan Laboratories, National Communicable Disease Center
17. Parasitic Diseases Branch, National Communicable Disease Center
18. Viral Diseases Branch, National Communicable Disease Center
19. Clinical Chemistry and Hematology Branch, National Communicable Disease Center
20. Licensure and Development Branch, National Communicable Disease Center

21. Microbiology Branch, National Communicable Disease Center
22. Scientific Resources Branch, National Communicable Disease Center
23. Technical Development Laboratories, National Communicable Disease Center
24. Tuberculosis Branch, National Communicable Disease Center
25. Venereal Disease Branch, National Communicable Disease Center
26. Office of Program Planning and Evaluation, National Institute of Mental Health
27. Division of Mental Health Service Programs, National Institute of Mental Health
28. Lexington Clinical Research Center, National Institute of Mental Health
29. Fort Worth Clinical Research Center, National Institute of Mental Health
30. Intramural Research Program, National Institute of Mental Health
31. National Center for Mental Health Service, Training and Research, National Institute of Mental Health
32. Office of Architecture and Engineering, Health Facilities Planning and Construction Service
33. Office of Consultation on Hospital Functions, Health Facilities Planning and Construction Service
34. Executive Office, Maternal and Child Health Service
35. Program Services Branch, Division of Health Services, Maternal and Child Health Service
36. Administrative Methods Branch, Division of Health Services, Maternal and Child Health Service
37. Nutrition Section, Division of Health Services, Maternal and Child Health Services
38. Division of Research, Maternal and Child Health Services
39. National Clearinghouse for Smoking and Health, Regional Medical Programs Service (queried, but provided no response)
40. Nutrition Program, Regional Medical Programs Service
41. Health Program Systems Center, Indian Health Service
42. Health Facilities Construction Branch, Headquarters, Indian Health Service
43. Health Facilities Construction Branch, Headquarters, Indian Health Service
44. Office of Environmental Health, Headquarters, Indian Health Service
45. Office of Environmental Health, Headquarters, Indian Health Service

46. Construction and Maintenance Branch, Alaska Area, Indian Health Service
47. Division of Emergency Health Service, Federal Health Programs Service
48. Nursing, USPHS Hospital, San Francisco, Federal Health Programs Service
49. Building and Grounds, USPHS Hospital, Staten Island, Federal Health Programs Service
50. Dietetics, USPHS Hospital, Staten Island, Federal Health Programs Service
51. Pharmacy, USPHS Outpatient Clinic, Washington, D.C., Federal Health Programs Service

Respondent — Health Area of National Responsibility:

1. Deputy Surgeon General

1. Mission of the Health Services and Mental Health Administration. The HSMHA is a central resource for improving the quality and accessibility of health care for the American people. It combines the direct medical care responsibilities of the Public Health Service with responsibilities for supporting the planning and construction of health facilities, the development of new systems for providing community personal health services, and the establishment of quality standards for all health services.

The HSMHA provides health and dental care to eligible beneficiaries through a system of Public Health Service hospitals and out-patient clinics. It provides medical care and preventive public health services to Indians and Alaskan natives. It administers health care programs for the Bureau of Prisons, U.S. Coast Guard, Bureau of Employee's Compensations, and the Peace Corps, and provides technical advice and personnel to assist other Federal agencies in developing health care programs for their employees or beneficiaries.

The HSMHA administers grant programs for the planning and construction of hospitals and related medical facilities, conducts and supports studies leading to the development of new or improved health service systems, develops criteria and standards for health care and health services, and develops plans for meeting civilian health needs in national emergencies.

The National Institute of Mental Health conducts or supports programs of research, manpower development and training, demonstrations, and community service to promote and sustain mental health, prevent mental illnesses, and treat and rehabilitate the mentally ill.

It develops mental health standards, provides consultative and technical services to State and community agencies, and provides grants for the construction and staffing of community mental health centers and for the provision of preventive mental health services. It serves as the principal Public Health Service focus for activities in the behavioral sciences, in social and cultural problems related to mental health, and in biological and psychosocial factors that determine human behavior and development.

The Institute focuses attention on special mental health problems through centers such as the National Center for Prevention and Control of Alcoholism, and centers for studies of narcotic and drug abuse, suicide prevention, crime and delinquency, child and family mental health, and metropolitan and regional mental health problems.

The Institute also supports or provides narcotic addict rehabilitation services and conducts clinical research studies and related patient care in this area.

2. Present Metric Usage. Present metric usage within HSMHA corresponds to that of the scientific community at large. Metric usage is well established in the health professions and the last vestiges of the avoirdupois, apothecary, and troy systems of weights and measures are now disappearing. On the other hand, the dietary and engineering professions are committed through education and capital investment to customary U.S. standards and units with apparently no trend toward metrication.

Currently, metric units are used by 31 of the 51 respondents in HSMHA. This use of metric measurement units is minimal except in scientific areas concerning:

(1) the provision of health services and hospital and out-patient medical care to designated beneficiaries;
(2) the provision of mental health service and hospital and out-patient mental health care to designated beneficiaries; and
(3) the conduct and support of research to control or prevent infectious and chronic diseases and to control or prevent mental illness.

In the practice of medicine, nursing, pharmacy, and other health professions, metric measurement units are used extensively in activities such as: drug prescribing, dispensing, and administration; clinical recording; formulation of pharmaceuticals; calibration of equipment such as weighing, measuring, and testing devices; specifications for drugs and chemicals; and laboratory equipment and tests. In supply and service departments, metric units of measurement are used in some production, quality control, and procurement activities. In food service departments, metric units are used for nutritional standards, units of time, and for reporting nutritional data. In engineering departments, the application of metric units is related to the review of foreign equipment specifications and literature and to the measurement of electrical current and luminous intensity.

Fourteen of the 51 HSMHA respondents use metric engineering standards in their activities. Electric current and luminous intensity standards are metric and there are metric standards for some water and sanitation equipment and for performing tests on boiler water. Supply and service departments use some metric engineering standards for purchasing, production, quality control, and research equipment of foreign manufacture. Laboratories use metric engineering standards in their lab work and in the maintenance and development of some equipment. However, the use of metric engineering standards is not extensive.

Twenty-seven HSMHA respondents cite specific advantages of current metric usage while only six respondents mention disadvantages. The most frequently mentioned advantages of metric usage relate to operational improvement, the fact that metric is conventionally used in related disciplines, and the facilitation of international cooperation. Lack of familiarity is the most frequently mentioned disadvantage.

3. Anticipated Changes if There is No National Plan for Metrication. Only six respondents (Viral Diseases Branch, Clinical Chemistry and Hematology Branch, Tuberculosis Branch, Lexington Clinical Research Center, the Executive Office of the Maternal and Child Health Service, and the USPHS Hospital, San Francisco – Nursing) anticipat increased use of metric units under this assumption. Changes will occur primarily in clinical measurements, dispensing of medication, labeling of bottles and volumes, and scientific communication. Only two respondents (Clinical Chemistry and Hematology Branch and the Division of Mental Health Services Program) anticipate increased use of metric engineering standards.

Changes will be brought about primarily by a desire to improve quality and performance and by increasing international and domestic use of the metric system. Only three respondents anticipate cost impacts as a result of these changes. The Viral Diseases Branch expects a net cost change of less than 1 percent (uncertain whether savings or increased cost). The Tuberculosis Branch expects annual costs to increase less than 1 percent (for new slugs, type metal, plates for labels, and forms). The USPHS Hospital, San Francisco (Nursing) expects a 1 to 5 percent savings because of increased simplicity and standardization brought about by metrication.

Twenty-nine of the 51 HSMHA respondents anticipate problems if no changes toward metrication are made by HSMHA. The most common anticipated problems are training of personnel, dual dimensioning, and increased conversions because of the increased metric usage outside of HSMHA.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption, 13 HSMHA respondents anticipate cost impacts during the transition period; 37 respondents anticipate no cost impact; and one respondent (Forth Worth Clinical Research Center) is unable to make an estimate.

The USPHS Hospital, San Francisco (Nursing) is the only HSMHA respondent to anticipate savings during the transition period of a nationally coordinated program to increase use of metric units of measurement; savings of under 1 percent are expected.

Six respondents expect their annual costs to increase by less than 1 percent during the transition period as follows:

a. Tuberculosis Branch of the National Communicable Disease Center – an annual increase of $1,000 for slugs, type metal, labels, etc.

b. Mental Health Intramural Research Program – an annual $4,500 increase in costs for instrument fabrication.

c. Office of Environmental Health in the Headquarters of the Indian Health Service—a $100,000 annual increase for equipment.
d. Both respondents of the Headquarters of the Health Facilities Construction Branch of the Indian Health Service together—a $16,000 increase annually.
e. Administrative Services Branch of the National Communicable Disease Center—$3,900 annually for contracting and supply management activities.

Three respondents expect their annual costs to increase by 1 to 5 percent during the transition period as follows:

a. Nutrition Program of the Regional Medical Programs Service—an annual $15,000 increase in costs.
b. Division of Emergency Health Services in the Federal Health Programs Services—a $50,000 increase in costs.
c. Dietetics Department of the USPHS Hospital, Staten Island—an annual increase of $10,500 for retraining, wastage, and loss of efficiency.

The National Center for Mental Health Services, Training and Research expects a 5 to 10 percent increase in costs or $36,500 annually during the transition period.

Two respondents anticipate an increased annual cost of 10 percent or more during the transition period as follows:

a. Construction and Maintenance Branch (Alaska Area) of the Indian Health Service—a yearly increase of $11,000.
b. Buildings and Grounds Department of the USPHS Hospital, Staten Island—a yearly cost increase of $9,000.

During the post-transition period of a nationally coordinated program to increase use of metric units of measurement, nine HSMHA respondents expect changes in their annual costs, 44 respondents expect no changes, one respondent (Fort Worth Clinical Research Center) is unable to make an estimate.

Four respondents expect cost savings of 1 to 5 percent during the post-transition period under Assumption II as follows:

a. Nutrition Program of the Regional Medical Programs Service—a savings of $10,000.
b. Both respondents of the Headquarters of the Health Facilities Construction Branch of the Indian Health Service together—savings of $96,000 yearly.
c. USPHS Hospital in San Francisco (Nursing)—an annual savings of $8,435.

The Construction and Maintenance Branch (Alaska Area) of the Indian Health Service expects savings of $11,000 per year or about 10 percent under Assumption II.

Two respondents expect cost increases of under 1 percent during the post-transition as follows:

a. Tuberculosis Branch in the National Communicable Disease Center.
b. Headquarters of the Office of Environmental Health in the Indian Health Service.

The National Center for Mental Health Services, Training and Research in the National Institute of Mental Health anticipates an annual cost increase of $15,000 or 1 to 5 percent during the post-transition period. Finally the USPHS Hospital, Staten Island (Building and Grounds) expects an annual cost increase of $9,000 annually, and the Office of Systems Management anticipates a 10 percent or more increase in annual costs during the post-transition period under this assumption.

Thirty-four of the 51 HSMHA respondents cite specific long-term advantages which would result from the adoption of metric units of measurement while only four respondents mention disadvantages. The most frequently mentioned advantages of the use of metric units are improvement of international communication and operational improvement. Cost increase is the most frequently mentioned disadvantage.

If there were a planned national effort to adopt metric measurement units, 16 of the 51 HSMHA respondents would face legal or operational problems. Primary impact would be in the areas of engineering, food services, and equipment and supply maintenance and servicing. There would be some operational impairment due to the need for education, conversion tables, and recalibration. It would be necessary to train administrative personnel, craftsmen, supply clerks, and other individuals concerned with the servicing and maintenance of equipment and supplies.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Measurement (Assumption III). Under this assumption, 13 HSMHA respondents anticipate cost impacts during the transition period; 37 respondents anticipate no cost impacts; and one respondent (Fort Worth Clinical Research Center) is unable to make an estimate.

The USPHS Hospital, San Francisco (Nursing) is the only respondent anticipating savings during the transition period under this assumption; savings are expected to be under 1 percent.

Four respondents expect an annual cost increase of under 1 percent during the transition period as follows:

a. Intramural Research Program in the National Institute of Mental Health -- an annual increase of $5,000 for instrument fabrication.
b. One respondent in the Office of Environmental Health in the Indian Health Service — annual added costs of $120,000 for revising specifications.
c. Tuberculosis Branch of the National Communicable Disease Center — an annual cost increase of $1,000 for slugs, type metal, labels, etc.

d. Administrative Services Branch in the National Communicable Disease Center – a $3,900 annual increase in contracting and supply management expenses.

Three respondents expect an annual cost increase of 1 to 5 percent during the transition period as follows:

a. The Division of Emergency Health Services in the Federal Health Programs Services – annual added costs of $75,000.
b. Nutrition Program of the Regional Medical Programs Service – an annual cost increase of $15,000.
c. Dietetics Department of the USPHS Hospital, Staten Island – an increase of $10,500 annually for training, wastage, and loss of efficiency.

The National Center for Mental Health Services, Training, and Research in the National Institutes of Mental Health expects an annual cost increase of $47,600, or 5 to 10 percent, during the transition period.

Four HSMHA respondents expect a 10 percent or more increase in annual costs during the transition period as follows:

a. Both respondents at Headquarters in the Health Facilities Construction Branch of the Indian Health Service together – an increase of $320,000 annually.
b. Construction and Maintenance Branch (Alaska Area) of the Indian Health Service – an annual increase of $11,000.
c. Buildings and Grounds Department of USPHS Hospital, Staten Island – an increase of $9,000 annually.

During the post-transition period of a nationally coordinated program to increase use of metric-based engineering standards as well as metric units of measurement, 10 respondents anticipate cost changes; 40 respondents anticipate no changes; and one respondent (Fort Worth Clinical Research Center) is unable to make an estimate.

Five respondents expect cost savings during the post-transition period under Assumption III as follows:

a. Nursing Department of the USPHS Hospital, San Francisco – a 5 to 10 percent savings or $8,435 per year.
b. Construction and Maintenance Branch (Alaska Area) of the Indian Health Service – a cost savings of 10 percent or $11,000 per year.
c. Both respondents of Headquarters, Health Facilities Construction of the Indian Health Service – a cost savings of 10 percent or $320,000 together.
d. Nutrition Program of the Regional Medical Programs Service – annual savings of $10,000 or 1 to 5 percent.

Five respondents expect a cost increase during the post-transition period as follows:

a. Mental Health Intramural Research Program – an annual cost increase of $500, or less than 1 percent, for instrument fabrication.

b. Headquarters of Environmental Health in the Indian Health Service—a cost increase of less than 1 percent.

c. Tuberculosis Branch in the National Communicable Disease Center—a cost increase of less than 1 percent.

d. National Center for Mental Health Services, Training, and Research—an annual cost increase of $18,200, or 1 to 5 percent.

e. Buildings and Grounds Department of the USPHS Hospital, Staten Island—an annual cost increase of $9,000.

Twenty-six of the 51 HSMHA respondents cite specific long-term advantages which would result from the adoption of metric-based engineering standards; only three respondents mention disadvantages. Improvement of international communication and operational improvement are the most often mentioned advantages of metric engineering standards, while cost increase is the most often mentioned disadvantage.

If there were a planned national effort to adopt metric engineering standards as well as metric units of measurement, 13 of the 51 HSMHA respondents would face legal or operational problems. Primary impact would again be in the areas of engineering and food services. Retooling and replacement of equipment and parts would have to be accomplished. Education programs would have to be conducted on the job. Thousands of U.S. standard stock items would have to be phased out and replaced. Warehouse labeling would have to be changed. Catalogs would have to be re-written. A dual system might have to be used for a long period. It is likely that in some organizations additional personnel would be needed to accomplish the change.

6. Conclusion. Thirty-one of 51 HSMHA respondents favor a nationally coordinated program to increase use of metric units of measurement, six respondents are opposed to such a program, seven respondents are uncertain, and the remainder provide no information. Twenty-six HSMHA respondents recommend a nationally coordinated program to increase use of metric engineering standards, five respondents are opposed to such a program, 13 respondents are uncertain, and the remainder provide no information. Members of the engineering and dietetics professions in general do not support metrication. Some are opposed to it. However, members of the scientific community who are familiar with the metric system favor it. This opinion is based on the simplicity of the metric system and the merits of having a uniform international system of units and standards.

Twenty of the 51 HSMHA respondents regard a 10-year period for transition to the metric system as satisfactory. Twenty-two respondents are unable to estimate the adequacy of a 10-year transition period and nine respondents recommend a transition period for metrication shorter than 10 years.

Of the nine respondents who recommend a transition period shorter than 10 years for metrication, one (Microbiology Branch) recommends a transition period of 1 year; two (Technical Development Laboratory and Tuberculosis Branch) recommend a transition period of 2 years; three (Fort

Worth Clinical Research Center, the Nutrition Program, and the Health Programs Systems Center) recommend a transition period of 3-5 years; and two (Venereal Diseases Branch, and Headquarters of the Office of Environmental Health) recommend a transition period of 5 years. Most of the respondents who favor a transition period shorter than 10 years for metrication point out that the metric system is already used extensively in their activities and that a shorter period would reduce or eliminate unnecessary duplication and confusion.

Impacts of Metrication on U.S. Health

Present Metric Usage. The Deputy Surgeon General estimates that the metric system is used in over three-quarters of all U.S. health activities. Over the past 20 years, the metric system has become universally used by the medical profession in its clinical practice and research. The Deputy Surgeon General estimates that increasing domestic and international use of the metric system has had a *negligible*[6] impact on U.S. health activities since the conversion to the metric system was done gradually.

Future Impacts of Metrication. Assuming that there is no concerted national action to promote increased use of the metric system, the Deputy Surgeon General estimates that increasing domestic and international use of the metric system would have a negligible effect on U.S. health activities. The health science world has completely converted to the metric system and the health professions are using the metric system almost exclusively.

If there were a nationally planned program to increase use of the metric system over a 10-year period, the Deputy Surgeon General estimates that such a program would probably have very little effect on U.S. health activities for the reasons cited above.

Increasing domestic and international use of the metric system is estimated by the Deputy Surgeon General to have had a *negligible* impact on HSMHA's ability to perform its mission with respect to the Nation's health activities. Metrication has resulted in better communication of clinical and health science data. Adoption of the metric system would probably improve HSMHA's effectiveness within U.S. health activities since, after conversion, technicians and aides would not have to be taught how to use the metric system when entering employment. The general public would probably understand dosages of pharmaceuticals better.

What Action Should Be Taken? The Deputy Surgeon General recommends a coordinated program to adopt the metric system.

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[6] See "Classification of Intensities of Impact" scale on p. 79.

NATIONAL INSTITUTES OF HEALTH (NIH)

Liaison Representative:

Grant Riggle, Biomedical Engineering and Instrumentation Branch, National Institutes of Health

Respondents—Internal Operations:

1. Chemical Engineering Section, Biomedical Engineering and Instrumentation Branch, Division of Research Services
2. Office of Engineering Services, Office of the Director of National Institutes of Health

The National Institutes of Health provides leadership and direction to programs designed to improve the health of the people of the United States. It conducts and supports research in the causes, prevention, and cure of diseases of man; administers programs to meet the Nation's health manpower requirements; directs programs for the collection, dissemination, and exchange of information in medicine and health; and administers Federal standards and licensing activities for biological products sold in interstate commerce.

The NIH scientific community regularly employs metric measurements in its biological, chemical, and clinical activities and reports, as is generally the case in life sciences. No significant problems or expenses are anticipated in this area should the SI system be adopted as standard for the United States.

NIH engineering, manufacturing, and service operations, however, do not regularly employ the metric system. There is a slight trend toward conversion to metric units. A substantial impact is certain to occur, should a transfer from English to metric standards be adopted. Cost increases for related operations are estimated to be 10 percent, and would continue up to 20 years after adoption of the SI system. Intensive and extensive educational training programs for all crafts personnel and associated engineering and administrative staff would necessarily continue for a 10- to 20-year period.

Equipment replacement and modification within NIH would continue during a 20-year term. Conversion costs and expense of maintaining dual inventories on parts and supplies would be substantial (about $50,000 annually during the transition period and $10,000 annual added cost after the transition), even under a planned obsolescence program. In general, personnel should have no severe difficulty in adapting to the metric system. The ultimate benefits derived from international uniformity should far outweigh the costs of making the transition.

OFFICE OF EDUCATION (OE)

Liaison Representative:

Albert R. Munse, Division of Statistical Information and Studies, National Center for Educational Statistics

Respondents — Internal Operations:

1. Editorial Services Division, Office of Public Affairs
2. Publications Division, Office of Public Affairs
3. Division of University Programs, Bureau of Higher Education
4. Division of Academic Facilities, Bureau of Higher Education
5. Division of International Services and Research Staff, Institute of International Studies
6. School Construction Branch, Division of School Assistance in Federally Affected Areas, Bureau of Elementary and Secondary Education
7. Division of Educational Services, Bureau of Education for the Handicapped
8. Division of Training Programs, Bureau of Education for the Handicapped
9. Division of Research, Bureau of Education for the Handicapped
10. Division of Manpower Development and Training, Bureau of Adult, Vocational, and Technical Education
11. Civil Defense Education Branch, Division of Adult Education Programs, Bureau of Adult, Vocational and Technical Education
12. Division of Vocational and Technical Education, Bureau of Adult, Vocational and Technical Education
13. Division of Library Programs, Bureau of Libraries and Educational Technology
14. Educational Broadcasting Facilities Program, Bureau of Libraries and Educational Technology
15. Division of Educational Laboratories, National Center for Educational Research and Development
16. Division of Elementary and Secondary Education Research, National Center for Educational Research and Development
17. Division of Comprehensive and Vocational Education Research, National Center for Educational Research and Development
18. Division of Higher Education Research, National Center for Educational Research and Development
19. Construction Support Division, Office of Construction Service

20. Facilities Development Division, Office of Construction Service
21. Contracts and Grants Division, Office of Administration
22. General Services Division, Office of Administration
23. Automatic Data Processing Division, Office of Administration
24. Equipment Development Branch, Office of Information Dissemination
25. Practice Improvement Division, National Center for Educational Communications
26. Educational Materials Center, Office of Information Dissemination
27. Data Services Bank, Division of Survey Operations, National Center for Educational Statistics
28. Publications and Information Branch, Division of Survey Operations, National Center for Educational Statistics

Respondent — Education Area of National Responsibility:

1. Program Officer, National Center for Educational Statistics

1. Mission of the Office of Education. The mission of the Office of Education (OE) is to collect statistics and facts which show the condition and progress of education in the U.S., to disseminate this information to aid the people of the United States in the establishment and maintenance of efficient school systems, and otherwise to promote the cause of education. The OE also administers Federal programs of financial assistance to education and conducts special programs and studies pertaining to education.

2. Extent of Present Metric Usage. Only three of the 28 respondents of OE currently use the metric system in their activities. The Division of Educational Services uses metric units in the production of films. The Civil Defense Education Branch of the Division of Adult Education Programs uses metric units and engineering standards in movie equipment, in the production of films, and radiation measuring devices. The Educational Broadcasting Facilities Program indicates use of funds by Federal grantees to buy foreign manufactured equipment which is based on the metric system. The Division of Educational Services is the only respondent to cite specific advantages of current metric usage: these are cost savings and facilitated international cooperation.

3. Anticipated Changes if There is No National Plan for Metrication. Only two respondents anticipate changes toward the metric system under this assumption. The Educational Broadcasting Facilities Program anticipates unspecified changes toward the metric system. Such changes are expected to increase annual internal costs by 5 to 10 percent. No legal problems are foreseen, but problems in operations are anticipated. Such changes should increase the program's capability because of the resulting simplification of standards. In time, the advantages of this transition are expected to outweigh the disadvantages. The Construction Support Division also anticipates unspecified changes toward metrication. Such changes are expected to require the training of personnel in metric usage and to cause an initial slowdown in review processes because of unfamiliarity with the metric system. In the long run, mission capability is expected to be enhanced by these changes because the Division will acquire a faster delivery capability. The advantages of changeover are expected to outweigh the disadvantages because of the resulting simplification of units and computations.

Ten of the 28 OE respondents anticipate problems if no changes toward increased metric usage are made by OE. The most common anticipated problems are increased inventories, dual dimensioning, and training because of the increasing metric usage outside of OE.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units and Metric-Based Engineering Standards. Only two respondents anticipate cost impacts under this assumption. The Educational Broadcasting Facilities Program expects costs to increase by $30,000 or by 5 to 10 percent during the transition period. During the post-transition period, annual internal savings of $30,000 or 5 to 10 percent are expected. The Division of School Assistance in Federally Affected Areas in the Bureau of Elementary and Secondary Education expects annual increased costs during the transition of about $1,500 for the conversion of data regarding about 1,500 construction projects. No cost impact is expected during the post-transition period. All other OE respondents foresee no cost impacts.

Ten respondents expect to realize long-term advantages under this assumption. More effective international promotion of U.S. standards and operational improvement are most often cited. Two respondents (General Services Division and Data Services Branch) anticipate long-term disadvantages under this assumption. These include cost increases and operational impairment. Eleven respondents think the advantages of metrication would outweigh disadvantages; three respondents do not think advantages would outweigh disadvantages; and eight respondents are uncertain.

To implement metrication, the Publications Division and the Division of Vocational and Technical Education would have to revise existing textbooks and manuals. The Division of Academic Facilities, the School Construction Branch of the Division of School Assistance in Federally Affected Areas, and the Data Services Branch would have to train personnel in metric usage, convert statistical data banks, and make necessary changes in forms, documents, and related materials. The Division of Vocational and Technical Education and the Construction Support Division would have to orient their personnel in metric usage. The Publications and Information Branch would have to start reporting survey facts in metric terms. The Division of Higher Education Research would have to assist research and development efforts in converting educational standards and help in revising engineering curricula to implement metrication.

Five respondents (School Construction Branch of the Division of School Assistance in Federally Affected Areas, the Educational Broadcasting Facilities Program, the Division of Elementary and Secondary Education Research, the Construction Support Division, and the Publications and Information Branch) anticipate problems other than cost problems in the event of metrication. These problems are anticipated primarily in the areas of operations and of education and training.

5. Conclusion. Twelve[7] of the 28 respondents of the Office of Education recommend a nationally coordinated program of transition to metric units of measurement and engineering standards. The remaining respondents make no recommendations on this issue. The Division of Educational Laboratories points out that metrication has implications for the elementary school arithmetic curriculum (less emphasis on fractions and more on decimals) and a study should be made of this matter. The Construction Support Division thinks the deans of engineering schools and professional engineering and architectural societies should be consulted on the issue of metrication.

Ten respondents regard a transition period of 10 years for metrication as satisfactory. Four respondents recommend a transition period of less than 10 years. Three of these respondents (Publications Division, Educational Broadcasting Facilities Program, and the Publications and Information Branch) recommend a 1-year transition period for metrication. The Educational Broadcasting Facilities Program thinks this shorter transition period would reduce its conversion costs and disruptions by 50 percent. The Civil Defense Education Branch, Division of Adult Education Programs, recommends a transition period of 5 years for metrication. This would minimize confusion and prevent unnecessary delays for the Branch. Fourteen respondents make no response under this question.

Impacts of Metrication on U.S. Education

Present Metric Usage. The Office of Education estimates that the metric system is used in less than one-quarter of all U.S. educational activities. Usage varies, depending on school grade level (elementary, secondary, or college) and course of study. No trends in metric usage in this area are discerned and OE estimates that increasing domestic and international use of the metric system has had a *negligible*[8] impact on U.S. educational activities.

Future Impacts of Metrication. Assuming that there is no concerted national action to promote increased use of the metric system, OE estimates that increasing domestic and international use of the metric system will have little or no effect on U.S. educational activities.

If there were a nationally planned program to increase use of the metric system over a 10-year period, OE estimates that minor cost benefits might result since then only one system of measurement would need to be presented. Most of the real benefits of such a conversion would probably be related to factors of international communication and standards.

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[7] These are: Publications Division in Office of Public Affairs, Division of University Programs in the Bureau of Higher Education, Civil Defense Education Branch in Division of Adult Education Programs, Educational Broadcasting Facilities Program, Division of Educational Laboratories, Division of Higher Education Research, Construction Support Division, Facilities Development Division, Automatic Data Processing Division, Equipment Development Branch in the Office of Information Dissemination, Practice Improvement Division, and Publications and Information Branch in the National Center for Educational Statistics.

[8] See "Classification of Intensities of Impact" scale on p. 79.

If the transition period exceeded 10 years but was less than 20 years, OE believes that the results of conversion would probably be the same as for a transition of 10 years duration. The Office cautions, however, that it might be more difficult to adopt a meaningful conversion program over a 20-year period. The tendency might be to delay adoption rather than institute conversion.

The OE estimates that increasing domestic and international use of the metric system has had a *negligible* impact on its ability to perform its mission with respect to U.S. education. Adoption of the metric system would improve OE's effectiveness within U.S. education. Improvement would result from having only one system of measurement to teach and use. Difficulties would result during the initial conversion period when extensive programs of population-wide national instruction would be necessary.

What Action Should Be Taken? The Office of Education favors conversion to the metric system because of the advantages of a common data base among nations. For education, however, conversion to the metric system will not result in changes which would affect the processes of instruction.

SOCIAL SECURITY ADMINISTRATION (SSA)

Liaison Representative:

Henry E. Jacob, Division of Operating Facilities

Respondents — Internal Operations:

1. Printing and Records Management Branch, Division of Operating Facilities, Office of Administration
2. Realty and Space Management Staff, Division of Operating Facilities, Office of Administration
3. Management Services Branch, Division of Operating Facilities, Office of Administration
4. Environmental Health Specialist, Employee Health Service, Office of Administration
5. Administration, Bureau of Data Processing and Accounts

1. Mission of the Social Security Administration. The Social Security Administration (SSA) administers the Federal retirement, survivors, disability, and health insurance programs.

2. Present Metric Usage. None of the five SSA respondents currently use metric units or engineering standards in their activities.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). No SSA respondents foresee any increased metric usage under this assumption. If no changes toward metric usage are made, two respondents anticipate problems because of increasing metric usage outside of SSA. The Printing and Records Management Branch, Division of Operating Facilities anticipates problems of dual dimensioning. The Office of Administration, Bureau of Data Processing and Accounts expects problems of training, dual dimensioning, and increased conversion and interfacing.

4. Anticipated Impact Under a Nationally Coordinated Program to Increase Use of Metric Units and Engineering Standards. Under this assumption no SSA respondents anticipate change in their costs during the transition and post-transition periods.

Two of the five SSA respondents cite specific long-term advantages which would result from the adoption of metric measurement units and engineering standards. The Realty and Space Management Staff, Division of Operating Facilities, cites operational improvement and better international promotion of U.S. standards as the long-term advantages of metrication. The Office of Administration, Bureau of Data Processing and Accounts cites improvement of international communication.

Only one respondent (Realty and Space Management Staff, Division of Operating Facilities) expects problems during the transition period under this assumption. These would occur in the areas of operations and education and training of personnel.

In adopting the metric system, problems faced by SSA are anticipated to be similar to those of other governmental agencies operating in a nonresearch or nonscientific environment. Metrication might have an impact on building construction and space layout work; on the design of forms; on numerous print shop functions; and on procurement processes. Conversions might have to be made in the area of automated data processing.

5. Conclusion. Two of five SSA respondents favor a nationally coordinated program of metrication and three are opposed to such a program.

Four of the five SSA respondents are unable to estimate the adequacy of a 10-year transition period for metrication. The Realty and Space Management Staff, Division of Operating Facilities, favors a transition period of 25 years for metrication, because transition to metric usage would be an involved process, especially for people involved in engineering and construction activities. The Staff also thinks an extended transition period would considerably minimize costs of transition and disruptions.

SOCIAL AND REHABILITATION SERVICE

Liaison Representative:

Emmett C. Dye, Division of Program Survey and Statistics, National Center for Social Statistics

Respondent — Internal Operations:

1. Division of Program Analysis, Assistance Payments Administration

The Social and Rehabilitation Service administers the Federal programs providing technical, consultative, and financial support to States, local communities, other organizations, and individuals in the provision of social, rehabilitation, income maintenance, medical, maternal and child health, family and child welfare, and other such services to the aged and aging, children and youth, the disabled, and families in need.

The Social and Rehabilitation Service was represented by the Division of Program Analysis, Assistance Payments Administration in the metric survey. The Division does not use metric units or engineering standards in any of its current activities. It does not plan to unilaterally adopt or increase usage of the metric system in any of its activities. No problems are foreseen in the absence of any moves on the Division's part toward metrication.

Under the assumption of a nationally planned program to increase use of metric units and engineering standards, the Division anticipates no direct cost impact nor does it expect any major transitional problems.

The Division makes no recommendations concerning a nationally planned program to increase use of metric units and engineering standards.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

Liaison Representative:

Robert E. Philpott, Acting Director of Building Technology and Certification Division, Office of the Assistant Secretary for Research and Technology

Respondents — Internal Operations:

1. Office of International Affairs, Office of the Secretary
2. Office of the Deputy Under Secretary for Policy Analysis and Program Evaluation, Office of the Secretary
3. Low Rent Public Housing Branch, Office of the Assistant Secretary for Mortgage Credit and Federal Housing Commissioner
4. Office of Technical and Credit Standards, Office of the Assistant Secretary for Mortgage Credit and Federal Housing Commissioner
5. Standards Branch, Office of the Assistant Secretary for Mortgage Credit and Federal Housing Commissioner
6. Products Acceptance Branch, Office of the Assistant Secretary for Mortgage Credit and Federal Housing Commissioner
7. Technical Standards (Land Planning), Office of the Assistant Secretary for Mortgage Credit and Federal Housing Commissioner
8. Metropolitan Planning Division, Office of the Assistant Secretary for Metropolitan Development
9. Office of Housing Management, Office of the Assistant Secretary for Renewal and Housing Assistance
10. Planning and Engineering Branch, Redevelopment Division, Office of the Assistant Secretary for Renewal and Housing Assistance
11. Office of Assistant Secretary for Equal Opportunity
12. Operation Breakthrough, Office of the Assistant Secretary for Research and Technology
13. Environmental Factors and Public Utilities Division, Office of the Assistant Secretary for Research and Technology
14. Urban Planning Research and Demonstration Program, Office of the Assistant Secretary for Research and Technology

Respondents — Environmental Pollution Control Area of National Responsibility:

1. Environmental Factors and Public Utilities Division, Office of the Assistant Secretary for Research and Technology
2. Deputy Director for Water Resources Research, Office of the

Assistant Secretary for Research and Technology

3. Environmental Planning Division, Office of the Assistant Secretary for Research and Technology

1. Mission of the Department of Housing and Urban Development. The purpose of HUD is to promote sound development of the Nation's communities and metropolitan areas in which the vast majority of its people live and work. To carry out such a purpose, HUD administers the following types of programs within the Federal Government: (1) assistance for housing and for the development of the Nation's communities; (2) assistance to the President in achieving maximum coordination of the various Federal activities which have a major effect upon urban community, suburban, or metropolitan development; (3) encouragement of solutions of problems of housing, urban development, and mass transportation; (4) encouragement of maximum contributions that may be made by vigorous private homebuilding and mortgage lending industries to housing, urban development, and the national economy; and (5) provision of appropriate consideration of the needs and interests of the Nation's communities.

2. Extent of Present Metric Usage. The metric system is used in only three of the 14 responding organizations; these are Office of International Affairs, Office of Technical and Credit Standards, and the Environmental Factors and Public Utilities Division.

The Office of International Affairs uses the metric system in the preparation of building standards and Technical Assistance Manuals for use in developing countries, and, also, for analysis and domestic application of foreign data from developing countries. The Office of Technical and Credit Standards says that drawings submitted in the jurisdiction of the San Juan, Puerto Rico office are typically detailed and dimensioned in metric units. The Environmental Factors and Public Utilities Division uses metric units and standards in scientific aspects of noise abatement research and in certain aspects of urban water management as well as other utilities research. In this case, the related scientific activities normally use metric units; however, engineering and industry prefer the customary system.

3. Anticipated Changes if There is No National Plan For Metrication (Assumption I). Under this assumption, only three groups anticipate any changes and only one of these (the Standards Branch in the Division of Architecture and Engineering) anticipates a schedule of specific changes. The Standards Branch expects to start using metric for descriptions of physical data in 1974 and descriptions of building measurements in 1976. With regard to hardware changes, the Branch expects performance standards in metric in 1974. The reasons for these changes are to improve the quality of performance in a world of increasing metric usage.

The Office of Technical and Credit Standards, and the Environmental Factors and Public Utilities Division do not specify their anticipated changes toward increased metric usage under Assumption I. Increased metric usage in the world, though, will lead to some increased metric usage within these two organizations.

Ten out of the 14 responding groups expect increasing problems if the groups make no changes toward further metric usage because of the increasing metric usage outside of HUD. The problems most often mentioned relate to: training, dual dimensioning, international cooperation, and increased conversion.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption, only three[1] responding subdivisions anticipate any cost impacts on their internal operations during the transition or post-transition periods; nine expect no cost impacts, and two (Operation Breakthrough and Office of Housing Management) are uncertain whether there would be any cost impacts.

The Office of International Affairs expects a cost increase of $6,000 annually, or 1 to 5 percent, due to a $2,000 increase for analysis of foreign data and a $4,000 increase for technical assistance to developing countries.

The Products Acceptance Branch expects a cost increase of $240,000 per year (10 percent or over) because of additional costs of $40,000 for revisions, $40,000 for training, $40,000 for publications, $20,000 for collaboration with industry, and $100,000 for administration.

The Office of Technical and Credit Standards expects additional costs of about $5,000 annually, or under 1 percent, for revising standards.

During the post-transition period, the Office of International Affairs expects an annual savings of $5,000, or 1 to 5 percent, due to a $2,000 annual savings for analysis of foreign data, and $3,000 savings annually for technical assistance to developing countries. The savings would result in large part from eliminating the necessity of converting foreign documentation for use domestically.

The Products Acceptance Branch expects added costs during the post-transition of $110,000 per year due to added costs of $20,000 for revision, $20,000 for publications, $20,000 for collaboration with industry, and $50,000 for administrative activities.

Operation Breakthrough and the Office of Housing Management cannot estimate the cost impacts during the post-transition period. The other 10 respondents expect no cost impacts.

The Office of the Deputy Under Secretary for Policy Analysis and Program Evaluation; the Office of Plans, Programs, and Evaluation in the Office of Assistant Secretary for Metropolitan Development; the Low Rent Public Housing Branch; Technical Standards (Land Planning) in the Office of the Assistant Secretary for Mortgage Credit and the Federal Housing Commissioner; the Planning and Engineering Branch in the Office of the Assistant Secretary for Renewal and Housing Assistance; the Standards Branch in the Office of the Assistant Secretary for Mortgage Credit and Federal Housing Commissioner; the Urban Planning Research and Demonstration Program in the Office of the Assistant Secretary for Research and Technology; Environmental Factors and Public Utilities Division; and the Program Planning and Evaluation Office in the Office of the Assistant Secretary for

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[1] The Urban Planning Research and Demonstration Program in the Office of the Assistant Secretary for Research and Technology expects no cost impacts on its internal operations. However, there would be some increased costs (about $100,000 per year) to the recipients of funds given for contract research under the Program. It is unlikely, however, that there would be any cost impacts on these contractors during the post-transition period.

Equal Opportunity do not expect any cost impacts on internal operations during either the transition or post-transition periods.

Nine out of the 14 respondents specify long-term advantages of metrication under Assumption II. All nine groups say that international communication would be facilitated; six groups say that U.S. standards could be more easily promoted internationally, which in turn would facilitate international trade and cooperation; six say that there would be cost decreases; and five groups say that there would be operational improvements (e.g., simplicity of calculations and decreased use of mixed units that cause ambiguities) due to metrication. Only the Office of Housing Management anticipates long-run disadvantages; this group does not foresee any long-term advantages.

Nine respondents believe that the advantages of metrication would outweigh the disadvantages. Only the Products Acceptance Branch (unless foreign trade in housing components expands tremendously) and the Office of Housing Management believe that the advantages would not outweigh the disadvantages.

Nine of the 14 respondents foresee specific problems within their groups aside from the costs of changeover in converting to the metric system. The chief problem would be in the retraining of personnel. There would also be operational problems such as human resistance to change, the use of a dual system, and loss of time spent in conversions. Some of the existing measurement equipment would become obsolete. The Urban Planning Research and Demonstration Program would have to know of changes that local governments make in codes relevant to the Program's efforts.

In order to implement a changeover, HUD believes it would have to establish training programs. Statistical and ADP systems whose files contain measurements needing conversions would have to be redesigned. Additional staff would have to be hired for revision of tables and standards, for training, and for collaboration with industry. There would be some minor procedural changes. All research contractors would be required to use the metric system. There would have to be simultaneous efforts on the part of HUD and local government in converting data records.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). Except for the Office of International Affairs, the cost impacts, the long-term advantages and disadvantages, the problems, and the implementation procedures under this assumption are virtually identical to those described under the prior assumption.

In addition to the annual cost increase of $6,000 described under Assumption II, the Office of International Affairs expects a cost increase of $2,000 annually during the transition period for documentation of foreign experience in metrication. There would be no cost impacts upon the Office during the post-transition period in addition to those post-transition impacts described under the prior assumption.

Under this assumption, the Office of International Affairs does not expect the long-term advantages of cost decrease and operational improvement that it expects under Assumption II. Because of this, the Office is uncertain, in this case, whether advantages of metrication would outweigh disadvantages.

6. Conclusion. In general, the HUD respondents are in favor of a concerted national program to bring about metrication in engineering standards as well as measurement units. Eleven of the 14 responding groups are in favor of such a program, one (Office of Housing Management) is not in favor, and two groups (Office of Metropolitan Planning and Development, and Program Planning and Evaluation Office in the Office of the Assistant Secretary for Equal Opportunity) are uncertain.

Three respondents advocate Congressional legislation requiring metric usage in the United States; these are the Products Acceptance Branch, the Low-Rent Public Housing Branch, and the Operation Breakthrough Program in the Office of Research and Technology. The Urban Planning Research and Demonstration Program respondent believes that the Federal Government should make the metric system official, and that special funds should be provided. The respondent in the Planning and Engineering Branch in the Office of Assistant Secretary for Renewal and Housing Assistance believes that the Government should require metric usage in its activities. The Office of International Affairs suggests that the Government should assist industry by investigating implications of a changeover and preparing a program of implementation. The Standards Branch respondent suggests a program of education and training on a nationwide level.

Only four out of the 14 responding groups believe that the 10-year transition period would be satisfactory. Four groups believe that a longer or shorter period would be more optimum. The Products Acceptance Branch thinks that a 15-year period would be better because of the complexity of the building industry. The Office of Housing Management believes that a 20-year period would be more satisfactory, but does not explain why. On the other hand, the Office of International Affairs believes that a 3-year period in converting to metric measurement units would be better since this would mean less time spent in a dual system; the Office already operates largely on the metric system. However, the Office of International Affairs does not know what the optimum transition period would be with regard to adopting metric engineering standards. The Urban Planning Research and Demonstration Program believes that a 5-year program would be better for it would reduce the time during which dual standards would have to be used.

Four of the respondents are uncertain what the optimum length of the transition period would be, and two respondents make no reply.

Impacts of Metrication on Environmental Pollution Control

Present Metric Usage. The metric system is used in less than one-quarter of all activities in environmental pollution control over which HUD has cognizance. There is no trend toward further metric usage. To the present time, the impact on pollution control activities over which HUD has responsibility has been *trivial*[2] from the increasing metric usage.

Future Impacts of Metrication. Assuming no concerted national action to increase metric usage, most changes caused by the increasing worldwide and domestic metric usage will cause few serious difficulties for HUD's environmental pollution control responsibilities.

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[2] See "Classification of Intensities of Impact" scale on p. 79.

If there were a planned national program to increase metric usage, a number of advantages would result. The advantages would include opportunities for interchangeable international usage of techniques and instruments necessary in environmental pollution control. No serious disadvantages are anticipated.

The impact on the ability of HUD to perform its mission with respect to its environmental pollution control responsibilities would be *trivial.* Some training, conversion of units, and some changes in measuring devices would be necessary. There would be improved effectiveness concerning use of international standards, international communication, and international cooperation.

What Action Should Be Taken? In the area of environmental pollution control, increased worldwide and domestic use of the metric system should be encouraged.

DEPARTMENT OF TRANSPORTATION (DOT)

Liaison Representative:

Robert D. Murphy, Office of Systems Requirements, Plans and Information

The Department of Transportation was created for the purpose of developing national transportation policies and programs in order to provide fast, safe, efficient, and convenient transportation at the lowest cost consistent therewith. The Department includes such operating agencies as the Coast Guard, Federal Aviation Administration, Federal Highway Administration. Federal Railroad Administration, Urban Mass Transportation Administration, Saint Lawrence Seaway Development Corporation, and the National Transportation Safety Board.

Following are subchapters which discuss the impacts of metrication upon the following organizations within the Department of Transportation:

1. Office of the Secretary
2. Coast Guard
3. Federal Aviation Administration
4. Federal Highway Administration
5. Federal Railroad Administration
6. Urban Mass Transportation Administration
7. National Highway Safety Bureau
8. National Transportation Safety Board

OFFICE OF THE SECRETARY OF TRANSPORTATION (OST)

Liaison Representative:

Robert D. Murphy, Office of Systems Requirements, Plans and Information

Respondents — Internal Operations:

1. Office of Facilitation, Office of the Assistant Secretary for Policy and International Affairs
2. Office of Noise Abatement, Office of the Assistant Secretary for Systems Development and Technology
3. Office of Hazardous Materials, Office of the Assistant Secretary for Systems Development and Technology
4. Office of Telecommunications, Office of the Assistant Secretary for Systems Development and Technology

Respondent — Policy and International Affairs Areas of Transportation:

1. Director, Office of Systems Requirements, Plans and Information

Respondent — Environmental Pollution Control Area of National Responsibility:

1. Office of Assistant Secretary for Environment and Urban Systems

1. Mission of OST. The Office of the Secretary of Transportation is responsible for the overall planning, direction, and control of departmental affairs. Within OST, four[1] offices are judged to be sufficiently concerned with metrication effects on internal operations to be included in the Survey.

These Offices are: (1) Office of Facilitation within the Office of the Assistant Secretary for Policy and International Affairs; (2) Office of Noise Abatement within the Office of the Assistant Secretary for Systems Development and Technology; (3) Office of Hazardous Materials within the Office of Assistant Secretary for Systems Development and Technology; and (4) Office of Telecommunications, also within the Office of Assistant Secretary for Systems Development and Technology.

The Office of Facilitation provides leadership in development and improvement of coordinated transportation services; identifies and resolves impediments in processes, procedures, and documentation related to modal and intermodal transportation; cooperates with industry and government in formulation of U.S. positions in international meetings; recommends necessary legislation; and fosters standardization of procedures, equipment, and techniques.

The Office of Noise Abatement provides department policy and guidance in transportation system noise abatement, research and development in intermodal generating, transmission, and human response to transportation noise, and domestic and international coordination on uniform noise standards.

The Office of Telecommunications is the focal point for all telecommunications activities of DOT, including developing basic policy, assuring a basic harmony of policy and purpose among the various operating administrations within DOT, sponsoring advanced and intermodal research and development and serving as the focal point for liaison with other government agencies and industry.

The Office of Hazardous Materials is concerned with enforcing regulatory provisions for container design, contents and transportation methods of hazardous materials.

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[1] Two offices in OST – Office of the Assistant Secretary for Policy and International Affairs and the Office of the Assistant Secretary for Environment and Urban Systems – provide information concerning impacts of metrication on transportation and environmental pollution control areas of national responsibility respectively. The impacts on these two organizational responsibilities are discussed on pp. 192–194.

2. Present Metric Usage. Three of the responding offices within the Office of the Secretary use metric measurement units and metric engineering standards. The Office of Facilitation, on the other hand, uses neither metric units nor standards.

The Office of Noise Abatement uses units and corresponding standards when working with length, time, mass, temperature, and electric current. The Office of Telecommunications uses metric because the electrical fields use metric units and standards. The Office of Hazardous Materials uses metric units and metric engineering standards in a few regulatory provisions for container design and contents for hazardous materials.

Advantages to the present metric usage within OST are operational improvement, increased international cooperation, and enhanced communication with scientific activities which normally use metric. The Office of Telecommunications is legally bound to use the metric system in some activities. No disadvantages are mentioned.

3. Anticipated Changes If There is No National Plan for Metrication (Assumption I). The Office of Hazardous Materials anticipates that in 1971 there will be a regulatory provision for free choice of units. This change will come about because suppliers may force the change, and because of the increasing worldwide and domestic usage of the metric system. The cost impact of this change will be very small, less than 1 percent, either plus or minus, of annual internal costs. The only costs involved will be for the manhours used in developing the conversion tables, and publication expenses.

Neither the Office of Noise Abatement nor the Office of Telecommunications anticipates any changes toward increased metric usage under Assumption I. The Office of Facilitation is uncertain whether there will be increased metric usage.

All four offices within OST cite problems if they do not make changes toward increased metric usage under Assumption I because of the increasing metric usage outside of OST. All four said there will be increasing problems of international cooperation. All except the Office of Hazardous Materials expect intensified problems of interfacing. The Office of Noise Abatement and Office of Telecommunications anticipate increased conversion problems. The Offices of Noise Abatement, Telecommunications, and Hazardous Materials believe that legal problems will become more serious. Finally, the Office of Hazardous Materials says that dual dimensioning will become more of a problem.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). All four responding offices anticipate no significant legal or other problems which would arise from metrication under this assumption. Because of this, there would be no internal savings or added costs to their offices resulting from metrication.

All four respondents in the Office of the Secretary agree that long-term advantages would result from metrication under Assumption II. The four believe that international communication and cooperation would be improved because of international uniformity and harmonization of standards. The Office of Noise Abatement and the Office of Hazardous Materials expect that metrication would help promote U.S. standards internationally. The Office of Noise Abatement cites operational improvement as a long-term advantage because of elimination of the time and effort needed in conversions. The Office of Hazardous Materials says that regulatory standards would be simplified. No disadvantages are cited by any of the four respondents. All four respondents expect that the advantages of the changeover under Assumption II would outweigh the disadvantages.

In order to implement the changeover under Assumption II, the Office of Facilitation would have to adopt size specifications based on the metric system. The Office of Noise Abatement would have to change internal orders; the Office of Hazardous Materials would have to publish conversion tables and omnibus regulatory changes. The Office of Telecommunications foresees no significant tasks in implementing the changeover.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). The four respondents within OST believe that the impacts and implementation tasks under this assumption would be identical to those under the prior assumption.

6. Conclusion. Three of the four offices within OST believe that there should be concerted action to bring about metrication in the United States in both measurement units and engineering standards. The Office of Facilitation does not know whether there should be concerted action. The Office of Noise Abatement believes that a 10-year transition period would be satisfactory. The others provide no opinion on the optimum length of the transition period.

The Office of Telecommunications believes there should be detailed studies on implementing the program by a joint government-industry-academic committee. The Office of Noise Abatement thinks that there should be training in metric units, internal orders, and a schedule on which the changes would be phased in. The Office of Hazardous Materials says there should be a program of conversion of household measures, travel distances, and educational systems. In addition, interface conversion tables would be needed to change over to metric engineering standards completely.

Impacts of Metrication on Policy and International Affairs Areas of Transportation

Present Metric Usage. The metric system is used in less than one-quarter of all activities in the policy and international affairs areas in OST. There is an increasing tendency to require the expression of international standards (safety, operating, certification) in dual measurement systems. This trend is evident in areas such as container standards and certification, and facilitation (document sizes). Thus far, the impact of the increasing metric usage throughout the world has had negligible impact on policy and international transportation affairs. The use of metric-customary conversion charts has solved most problems.

Future Impacts of Metrication. Assuming no concerted national action to increase metric usage, the overall effect on the policy and international affairs areas will be negligible. OST will require at most a review of existing legislation to ensure that metrication has not adversely affected transportation standards.

A nationally planned program to increase the use of the metric system would require OST to review all DOT legislation to ascertain the impact of metrication on transportation standards. A period longer than the proposed 10-year transition period would require a corresponding increase in staff work to maintain a continuous review of the impact of metrication, resulting in increased cost to DOT as compared to the 10-year period.

The adoption of the metric system would probably improve the effectiveness of the OST with regard to policy and international affairs because of fewer errors due to a less complex measurement system.

What Action Should Be Taken? OST recommends that it should participate in the development and acceptance of international transportation standards expressed in metric units, and also that it should examine the feasibility of requiring the use of the metric system to define standards for specific segments of the domestic transportation system.

Impacts of Metrication on Environmental Pollution Control Responsibilities of OST[2]

The Office of the Assistant Secretary for Environment and Urban Systems is responsible for developing innovative solutions to urban transportation problems; providing leadership in the initiation of urban transportation systems and urban environmental enhancement programs; and serving as the catalyst for translating these programs into balanced transportation projects through coordination of the resources of the Department, other governmental agencies, and private industry. The Office is concerned with transportation planning and environmental protection measures from a "non-hardware" standpoint.

Present Metric Usage. The metric system is not used to any significant degree within the environmental pollution control responsibilities of the Office of the Assistant Secretary for Environment and Urban Systems. There is no trend toward further usage and, assuming no concerted national program to increase metric usage, neither the Office nor its responsibilities will be affected by the otherwise increasing metric usage throughout the world.

Future Impacts of Metrication. If there were concerted national action to increase metric usage, improved cooperation with other nations would result. Increased use of the metric system could facilitate international cooperation on minimal standards for pollution of the oceans and for aircraft noise.

The Office is responsible for making the operating administrations in the DOT more responsive to the requirements of local governments and more sensitive to the needs for the protection and enhancement of the environment. To the extent that increasing metric usage would improve the consideration of broad environmental and social factors in planning and implementing transportation systems, such increased use would aid the Office in carrying out its responsibilities. The impact on the ability of the Office to perform its mission would be minimal.

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[2] Information provided by Office of the Assistant Secretary for Environment and Urban Systems.

What Action Should Be Taken? The Office does not believe that it has adequate expertise in the metric field to suggest whether there should be concerted national action to increase metric usage in the United States.

U.S. COAST GUARD

Liaison Representative:

W. O. Henry, Office of Engineering

Respondents — Internal Operations:

1. Office of Public and International Affairs
2. Office of Engineering
3. Office of Operations
4. Office of Merchant Marine Safety
5. Office of Research and Development

Respondent — Transportation (Shipbuilding) Area of National Responsibility:

1. Office of Merchant Marine Safety

Respondent — Maritime Environmental Protection Area of National Responsibility:

1. Maritime Pollution Control Branch, Law Enforcement Division, Office of Operations

Respondent — Boating Safety Area of National Responsibility:

1. Office of Boating Safety

1. Mission of the U.S. Coast Guard. The Coast Guard is a service within the Department of Transportation except when operating as part of the Navy in time of war or when the President directs. The Coast Guard is charged with the following responsibilities: carrying out search and rescue operations and safety activities such as removal of dangers to navigation; inspecting, licensing, and regulating vessels and related equipment as part of its merchant marine safety program; maintaining a state of readiness to function as a service in the Navy in time of war; establishing and maintaining aids to maritime navigation such as lighthouse and electronic aids; enforcing rules and regulations governing the security of ports and the anchorage and movements of vessels in territorial waters; enforcing all applicable Federal laws on the high seas or on navigable waters of the U.S.; providing meteorological and oceanographic data for other Government agencies; and providing ice-breaking services for domestic marine commerce and military operations. All of these responsibilities would be affected to some extent by a program of metrication.[3]

2. Extent of Present Metric Usage. Metric measurement units and metric engineering standards are used in all five of the responding subdivisions. The following activities use metric units:

Office of Public and International Affairs—telecommunications almost wholly metric; dual systems in international agreements.

Office of Engineering—Electronics, Civil, and Ocean Engineering Divisions.

Office of Operations—oceanographic measurements, weapon and ammunition dimensions, lighthouse and buoy lenses, communication engineering and equipment.

Office of Research and Development—because of the wide diversity of engineering and scientific disciplines and activities, both the customary and metric systems are used.

Office of Merchant Marine Safety—review of hazardous cargoes · carried by foreign ships, international maritime conferences.

All respondents cite facilitated international cooperation as an advantage to present metric usage. Operational improvement is cited as an advantage by the Office of Engineering; better communication with related scientific activities is cited by the Office of Public and International Affairs, the Office of Operations, and the Office of Engineering. The Office of Engineering cites cost savings as an advantage. The use of metric units helps in the review of drawings and specifications, particularly in the field of marine safety. The Office of Research and Development believes that the present necessity to use both customary and metric units and standards is an unfortunate legacy. The resultant need to use conversion factors in engineering computation is a simple but potentially unnecessary operation.

The advantages of using metric engineering standards are the same as those cited for the use of metric measurement units, except that there are no cost savings within the Office of Engineering.

Only the Office of Engineering and the Office of Operations identify disadvantages to their use of metric measurement units or metric engineering standards. The Office of Engineering cites lack of familiarization, legal requirements, and the fact that the engineering profession and industry prefer customary standards. These disadvantages, however, are slight and are limited to the civil engineering field. The Office of Operations believes that lack of familiarity is the disadvantage in their use of both metric measurement units and metric engineering standards.

The Office of Public and International Affairs and the Office of Engineering say that the advantages of their present metric usage outweigh the disadvantages.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Only one respondent anticipates changes toward the metric system under Assumption I. The Office of Operations says that in 1972, ocean depth measurements will be given in meters. This change will occur because of the increasing worldwide usage of the metric system. The added cost of this change should be minimal (less than 1 percent), and will be due to training and equipment costs.

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[3] The impact of metrication on the military readiness activities of the Coast Guard is covered by the Department of Defense Metric Study.

Three offices foresee intensified problems if they do not adopt further metric usage under Assumption I because of the increasing metric usage outside the Coast Guard. The Office of Engineering foresees problems of training, dual dimensioning, waste, increased inventory, increased conversion, and increased interfacing. The Office of Operations cites dual dimensioning as an increasing problem. Finally, the Office of Merchant Marine Safety says that if it does not adopt greater metric usage, there will be intensified legal problems and problems of training, dual dimensioning, international cooperation, and increased conversion.

Under this assumption, one respondent (the Office of Public and International Affairs, which is already on the metric system) does not anticipate problem areas developing if it does not adopt further metric usage.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). The Office of Engineering expects cost increases of less than 1 percent during both the transition and post-transition periods. The Office of Engineering lists annual added costs for the following activities:

	Transition period	Post-transition period
Office of Engineering:		
Aids to navigation	$110,000	$55,000
Marine sciences	5,000	2,500
Training	100,000	20,000
Conversion of specs	100,000	50,000
Electronics procurement	40,000	5,000
Total	355,000	132,500

The Office of Operations expects a cost increase of about $3 million annually (or under 1 percent) during the transition period; the Office expects no cost impact during the post-transition period. The three remaining respondents expect no cost impacts.

All of the responding offices believe that in the long term there would be advantages resulting from metrication under Assumption II. The advantages cited are: cost decreases by the Office of Public and International Affairs and Office of Operations; promotion of U.S. standards internationally by Office of Engineering, Office of Merchant Marine Safety, and the Office of Operations; and improved international communication by all the respondents. Another advantage cited is the reduction in core requirements in computers.

Disadvantages over the long term are cited by two respondents. The Office of Research and Development and Office of Engineering believe that there would be cost increases in the total conversion to the metric system.

Four respondents expect that the advantages of the changeover would outweigh the disadvantages. The Office of Merchant Marine Safety has no firm opinion on this subject.

In order to implement the changeover, the Coast Guard would have to train engineering personnel, dual dimension some drawings and specifications, change some technical publications, and phase in some new equipment.

Three offices anticipate problems under Assumption II. The Office of Engineering expects problems regarding operations, maintenance and equipment, education and retraining, and waiting for lagging industry to catch up. Some equipment would probably have to be retired prematurely in order that the organization could be more cost effective. The Office of Operations says that certain tools and equipment would have to be acquired.

The Office of Merchant Marine Safety would have certain unique problems. In many cases there might be a loss in safety in some of its regulation measurements as a result of numerical round off. Many of the exact numbers used in expressions such as "not greater than . . . feet" or "not to be less than . . . feet" are based on current engineering practice and contain known factors of safety. As these numbers are converted to their metric equivalents and rounded off to convenient metric numbers, much of this factor of safety and rationale is lost. An example is the conversion of 10 feet to 3.048 meters. However, rounding off to 3 meters (which equals 9.843 feet) may not provide the desired safety margin.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). The Office of Engineering and the Office of Operations anticipate internal added costs for their subdivisions under Assumption III. The Office of Engineering (which expects a cost increase of 5 to 10 percent during the 10-year transition period and for an indefinite period beyond) specifies the activities and the annual dollar figures as follows:

	Transition period	Post-transition period
Office of Engineering:		
Aids to navigation	$880,000	$88,000
Marine sciences	40,000	4,000
Training	100,000	20,000
Conversion of specs	500,000	100,000
Electronics procurement	200,000	10,000
Custom manufacture of parts to engineering systems	1,000,000	2,000,000
Total for Office of Engineering	2,720,000	2,222,000

The Office of Operations anticipates an annual cost increase of $10 to $15 million (or 1 to 5 percent) during the transition period and no cost impact during the post-transition period. The three remaining Coast Guard respondents expect no cost impacts.

Following the transition period, all respondents foresee long-term advantages. All offices believe that international communication would be improved. Three offices (Engineering, Operations, and Merchant Marine

Safety) believe that promotion of U.S. standards internationally would be helped The Office of Engineering thinks there would be operational improvement. Cost decreases are expected by the Office of Public and International Affairs.

Two offices forecast disadvantages: the Office of Engineering and the Office of Research and Development say that there would be long-run cost increases.

Four of the offices (Public and International Affairs, Engineering, Operations, and Research and Development) believe that the advantages of the changeover would definitely outweigh the disadvantages. The Office of Merchant Marine Safety has reservations about the relative advantages and disadvantages.

All offices believe that the implementation procedures would be the same whether under Assumption II or III, except for the Office of Engineering. The latter says that in addition to the steps cited under Assumption II, the Office must insure procurement of new equipment in the metric system.

The Office of Engineering anticipates operational, maintenance and equipment, and educational and retraining problems. There would be problems caused by prolonged periods of operation using double standards because of inability to procure parts for maintenance at a reasonable cost. Engineering also says that there would be problems concerned with changing directives to comply with industry standards. The Office of Operations expects problems concerned with maintenance and replacement of some equipment, and education and training of personnel.

6. Conclusion. Three of the Offices (Public and International Affairs, Engineering, and Operations) believe that there should be concerted action in the United States to bring about changes toward metrication in both standards and units. The concerted actions suggested are retraining, and use of metric units and standards in all federal procurement. The Office of Engineering suggests a 5-year transition period if there is metrication in units only; the Office of Engineering suggests a 10-year transition period if there is metrication in standards as well as units.

The Office of Engineering believes that the change is inevitable and should be made as soon as possible to keep costs down. The Office of Operations states that it is "totally inconsistent with orderly thinking, planning, management, etc., to continue to use the complex English system when a perfectly logical, orderly decimal system exists."

The Office of Merchant Marine Safety is uncertain on whether it favors such a program.

Impacts of Metrication on Shipbuilding

Present Metric Usage. The metric system is used in between one-quarter and three-quarters of all work applications in shipbuilding. To the present, the impact of the increasing metric usage has had, in some cases, a *severe*[4] impact on shipbuilding. In many cases, two standards must be used since a convenient dimension in one system is generally awkward to use in the other. The difficulties of the current situation impair the ability of the Coast Guard in dealing with its responsibilities concerning shipbuilding.

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[4] See "Classification of Intensities of Impact" scale on p. 79.

Future Impacts of Metrication. The present difficult situation concerning shipbuilding will continue if there is no concerted national action to increase the use of the metric system. The Coast Guard believes that unless the U.S. acts now to convert to the metric system, the U.S. shipbuilding industry would fall further out of step with the rest of the world.

What Action Should Be Taken? The United States should convert to the metric system as soon as possible.

Impacts of Metrication on Maritime Environmental Pollution Control

Present Metric Usage. The metric system is used in less than one-quarter of all work activities in the maritime environmental pollution control field and there appears to be no trend toward greater metric usage. The increasing worldwide and domestic metric usage has had *trivial* impact on maritime pollution control since measuring instruments and technical activities have had to use the metric system for many years. Most other problems caused by the increasing metrication have been solved by using conversion charts.

Future Impacts of Metrication. If there is no concerted national action to increase the use of the metric system, some increased inconvenience will result within the pollution control field due to increased simultaneous use of both the customary and metric systems.

A concerted national effort to increase the use of the metric system would have very little effect on the maritime environmental pollution control field. However, adoption of the metric system would improve the effectiveness of the Coast Guard in dealing with maritime pollution problems. Everyone would be familiar with the same units and conversion between larger and smaller units would be easier. International communication would be facilitated. Metrication would have *trivial* impact on the ability of the Coast Guard to perform its mission with respect to maritime pollution.

What Action Should Be Taken? From the standpoint of maritime environmental pollution control, it would be desirable to encourage adoption of the metric system immediately or as soon as possible.

Impacts of Metrication on Boating Safety

Present Metric Usage. The metric system is used in less than one-fourth of all work activities relating to boating safety and there appears to be no trend toward increased usage. The impact of the increasing worldwide and domestic use of the metric system has been *negligible* on the boating safety field. The U.S. market for pleasure craft is the largest in the world and other nations follow the U.S. lead in this product area. Because most boating lines are not standardized, problems of interchangeability due to metrication are minimized.

Future Impacts of Metrication. If there were a concerted national program to increase metric usage, there would be very little impact on the boating safety field and there would be *negligible* impact on the ability of the Coast Guard in performing its mission. Some regulations, standards, etc., would have to be changed to conform to the metric system. However, any change should be made soon, in order to avoid increased costs of postponed metrication.

What Action Should Be Taken? The United States should convert to the metric system immediately before the Coast Guard develops new regulations and standards in accordance with the customary measurement system.

FEDERAL AVIATION ADMINISTRATION (FAA)

Liaison Representative:

R. H. Clinkscales, Flight Standards Service

Respondents — Internal Operations:

1. Airports Service
2. Air Traffic Service
3. Office of Aviation Economics
4. Flight Standards Service
5. Office of International Aviation Affairs
6. Logistics Service
7. Systems Research and Development Service

Respondents — Air Transportation Area of National Responsibility:

1. Administrator, Federal Aviation Administration
2. Director, Office of Aviation Policy and Plans

Respondent — Aviation Safety Area of National Responsibility:

1. Flight Standards Service

Respondent — Environmental Pollution Control Area of National Responsibility:

1. Systems Analysis Staff

1. Mission of the Federal Aviation Administration. FAA is charged with the following responsibilities: regulating air commerce to promote its safety and development; achieving the efficient use of the navigable airspace of the United States; promoting, encouraging, and developing civil aviation; developing and operating a common system of air traffic control and air navigation for both civilian and military aircraft; promoting the development of a national system of airports; issuing and enforcing rules, regulations, and minimum standards relating to the manufacture, operation, and maintenance of aircraft as well as the rating and certification of airmen; locating, constructing, installing, maintaining, and operating Federal visual and electronic aids to air navigation; providing a system for the registration of an aircraft's nationality, its engines, propellers, and appliances as well as a system for recording aircraft ownership; and promoting civil aviation abroad by the assignment of technical groups, the training of foreign nationals, and the exchange of information with foreign governments.

2. Present Metric Usage. Only two of the responding subdivisions in FAA use the metric system to any noticeable extent. Airports Service uses metric units in reporting airport dimensional units to the International Civil Aviation Organization (ICAO).

The Systems Research and Development Service uses both metric units and standards to a limited extent because of legal requirements and because related scientific activities generally use the metric system.

3. Anticipated Changes If There is No National Plan for Metrication (Assumption I). Only two of the subdivisions in the FAA anticipate any changes toward metric under Assumption I. The Office of International Aviation Affairs plans increased use of metric units equivalents (not including metric engineering standards) in internationally distributed publications starting in 1972. These changes will occur because of the increasing worldwide and domestic usage of the metric system. Costs of such changes will be negligible.

The Systems Research and Development Service says that there will be increased use of metric units and standards in its operations but does not say when these changes will take place or what they will be. The changes will occur because of the increasing domestic usage of the metric system, and because suppliers may force them. The changes toward increased metric usage will lead to added costs of 10 percent or more due to drafting costs for conversion and also for double labeling. No legal problems are anticipated, but there will be problems with logistics and with suppliers.

The respondents have identified problem areas that would exist in their subdivisions if no changes were made toward metrication under Assumption I because of the increasing metric usage outside of FAA. Problems of international cooperation are mentioned by the Air Traffic Service, Office of International Aviation Affairs, and Logistics Service. Dual dimensioning problems would increase within the Airports Service and the Air Traffic Service. The latter mentions additional problems concerning training, increased conversion, increased interfacing, and legal areas.

4. Anticipated Impacts Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). Under this assumption, the cost impact would not be significant for most of the respondents within the FAA. The Systems Research and Development Service believes that there would be a cost increase of over 10 percent (or about $1,500,000 per year due to added costs for dual dimensioning) during the transition period. However, there would be little significant added cost or savings within the Service due to metrication in the post-transition period. The Air Traffic Service expects a cost increase of about $200,000 per year (less than 1 percent) due to necessary changes in instrumentation; no cost impact is anticipated after the transition period. No other respondents expect any cost impacts.

A number of long-term advantages in going metric under Assumption II are expected by the respondents. Most believe that better promotion of U.S. standards internationally and improved international communication would result. In addition, the Air Traffic Service says that there would be operational improvement in that organization.

Four respondents (Airports Service, Office of International Aviation Affairs, Air Traffic Service, and the Systems Research and Development Service) say that the advantages of the changeover would outweigh the disadvantages primarily because there would be a single worldwide measurement system. The Flight Standards Service expects that the advantages would not outweigh the disadvantages.

In implementing the changeover, the FAA would have to revise its drawings, specifications, and standards, change rules and regulations, retrain personnel, and review its existing publications and documents to incorporate metric units.

Only the Systems Research and Development Service and the Air Traffic Service expect to be significantly affected by metrication under Assumption II. The Systems R&D Service believes that there would be operational problems and also problems connected with equipment and maintenance. Also, all drawings, specifications, and standards would have to be revised. The Airports Service expects retraining problems (air traffic controllers and flight personnel would need retraining). This would involve extra workload and air-ground communications time. All other responding subdivisions in FAA anticipate no problems under Assumption II.

In the aviation world, some very real, practical problems exist that would make *rapid conversion* to the metric system costly. The most difficult problem in world aviation would be the use of metric units for aircraft altitude, elevations and heights, and vertical speed. The preponderance of the world's aircraft use customary units for calibration of their instruments in these elements, and air traffic control procedures affecting the bulk of civil aviation also use customary units to be compatible with the instrumentation. Many of the countries that use metric units exclusively for other purposes make an exception in the case of air traffic control procedures.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). The impacts upon FAA would be virtually the same under Assumption III as under Assumption II.

6. Conclusion. Four respondents believe that there should be concerted action in the United States to bring about changes toward metrication in measurement units and engineering standards. These four are: Airports Service, Air Traffic Service, Office of International Aviation Affairs, and Systems Research and Development Service. The concerted actions which the respondents suggest are: mandatory use of metric units and standards by government and industry, legislation requiring metric usage, increase metric usage in schools, dual dimensioning of all commercial products, and programs advocating public acceptance of metric usage.

Only one respondent, the Flight Standards Service, is against concerted action to bring about changes toward increased metric usage.

Impacts of Metrication on Air Transportation

Present Metric Usage. The metric system is used in less than one-fourth of the work activities in American air transportation. There appears to be a trend toward further metric usage. Some aircraft manufacturers are now developing drawings and specifications in metric units before translating to customary equivalents.

As the U.S. is the world leader in civil aviation, and the noncommunist world air transport system is based primarily on customary units, there has been *trivial*[5] impact on air transportation so far from the increasing worldwide metric usage. However, the International Civil Aviation Organization (ICAO) currently has a panel considering steps toward "unification of units of measurement in air/ground communications." Since 1964 the situation in world civil aviation has been that there are two tables of dimensional units approved for use by ICAO members, the so-called "ICAO Table," which is entirely metric and the "Blue (interim) Table" which is identically metric except for the units of measurement of altitudes, elevations and heights (English feet) and vertical speed (feet per minute). There has been a trend in recent years of more countries adopting the use of the "Blue Table." However, there is also a history in recent ICAO Assemblies of the U.S. being consistently outvoted on issues related to eventual standardization on the "ICAO (metric) Table" of dimensional units.[6]

The impact of increasing metric usage on the ability of the FAA to perform its mission has been *negligible.*

Future Impacts of Metrication. Assuming no concerted national action to increase metric usage, the increasing worldwide and domestic metric usage will lead to increased costs for tools and support equipment to handle a dual mode system. If aircraft flight separation standards are changed, air traffic controllers will have to learn a new system of altitude and distance measurement; this would present a substantial problem.

If there were a planned national program to increase metric usage, substantial costs would be incurred initially by both the FAA and the aviation community in retooling and new inventories. In addition, unfamiliarity with metric distances would, for safety reasons, slow the handling of air traffic during the conversion. Major reprogramming of computerized air control systems would be required.

Several numerical indicators could be used as measures of the impact of metrication on air transportation: U.S. aircraft sales to foreign airlines; inventory levels of FAA, aircraft firms, and airline companies; indirect operating costs within airlines and FAA; and lengths of aircraft delays.

Adoption of the metric system by the air transportation industry in the United States would improve the effectiveness of the FAA in dealing with its responsibilities. There would, however, be a severe readjustment period in technology and air traffic control methods during which effectiveness would decrease. Eventually, improvements in U.S. technology sales and interfaces with foreign concerns and countries could be expected. However, total system effectiveness would not increase substantially in the long run. A decision to convert to the metric system would have *substantial* impact on the ability of FAA to perform its mission.

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[5] See "Classification of Intensities of Impact" scale on p. 79.

[6] This information was extracted from two internal reports of the Interagency Group on International Aviation: Draft U.S. Position for the Sixteenth Session of the ICAO Assembly—Agenda Item 19—Consideration of a Progress Report on Unification of Units of Measurement (1968), and Extract from the Report of the Chairman of the United States Delegation to the Sixteenth Session of the Assembly of the International Civil Aviation Organization (1968).

What Action Should Be Taken? FAA believes that in the long run, conversion to the metric system would be desirable to standardize technology and control in worldwide aviation. The U.S. should encourage a conversion process over a minimum of 15 years.

Impact of Metrication on Aviation Safety

Present Metric Usage. The metric system is used in less than one-quarter of all work activities in the aviation safety field. There is a trend toward increasing metric usage in the engineering and some research and development areas. Most aviation medicine activities use the metric system. Generally, the impact on aviation safety from the increasing worldwide and domestic metric usage has been *negligible* except in the areas of research and development, engineering, and aviation medicine. FAA's ability to perform its mission has not been impaired or affected by the increasing metric usage.

Future Impacts of Metrication. If there is no concerted national action to increase metric usage, there will be negligible impact on the aviation safety field. However, if there were concerted national action, the effectiveness of FAA in dealing with its aviation safety responsibilities would be impaired in the areas of altimeters, vertical speed indicators, and airspeed indicators.

What Action Should Be Taken? This FAA respondent does not believe that any action should be taken to increase metric usage in the United States with respect to FAA's activities.

Impact of Metrication on Aviation Pollution Control

Present Metric Usage. The metric system is used in less than one-quarter of all aviation pollution control activities. There appears to be no trend toward increasing metric usage. The impact on aviation pollution control from the increasing worldwide and domestic metric usage has been *negligible*.

Future Impacts of Metrication. The impacts of metrication on the aviation pollution control field and upon the ability of the FAA to deal with its responsibilities in this field would be *negligible*. This would be the case whether there would or would not be a concerted national action to increase metric usage.

FEDERAL HIGHWAY ADMINISTRATION (FHWA)

Liaison Representative:

Lester P. Lamm, Office of the Director, Bureau of Public Roads

Respondent — Internal Operations:

1. Office of the Director, Bureau of Public Roads

Respondent — Highway Transportation Area of National Responsibility:

1. Administrator, Federal Highway Administration

1. Mission of the Federal Highway Administration. The Federal Highway Administration carries out the highway transportation programs of the Department with respect to Federal and Federal-aid highway construction, administration, and research; highway safety under provisions of the Highway Safety Act of 1966; and motor carrier safety functions under provisions of the Interstate Commerce Act that were transferred to the Department of Transportation. The Federal Highway Administration seeks to coordinate highways with other modes of transportation to achieve the most effective balance of transportation systems and facilities under cohesive Federal transportation policies. The major subdivisions of the Administration are the Bureau of Public Roads and the Bureau of Motor Carrier Safety.

Only the Bureau of Public Roads (BPR) is participating in the metric survey. BPR administers the Federal-Aid Highway Program of financial assistance to the States for highway construction. The Bureau also administers the Highway Beautification Program and other authorized related programs.

2. Extent of Present Metric Usage (BPR). According to the respondents, BPR does not use metric measurement units or metric engineering standards in any of its work.

3. Anticipated Changes If There is No National Plan for Metrication (Assumption I). The respondents do not know whether any groups within BPR will make changes toward greater usage of metric measurement units or metric engineering standards. If, however, BPR does not make changes toward greater usage of metric under Assumption I, problems will result in the following areas: training, dual dimensioning, international cooperation, increased interfacing, and legal.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption, BPR's annual cost of operation would increase by less than 1 percent because of an annual added cost of about $1 million for training and printed matter. During the post-transition period there would be an annual savings of less than 1 percent of the operating budget because of an annual savings of about $800,000 for "engineering" activities.

The long-run advantages resulting from metrication under Assumption II are cost decreases, operational improvement, better promotion of U.S. standards internationally, and improved international communication. No long-term disadvantages are cited by the respondents. The advantages of common language usage throughout the world resulting from the changeover would outweigh disadvantages.

In implementing the changeover, BPR would have to establish priorities among the various transportation areas such as highways or bridges. No problems are anticipated in areas of operations, maintenance and equipment, or retraining. No legal problems are foreseen.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). Under this assumption annual costs within BPR would increase by $7,000,000 (or less than 1 percent) because of increased design costs. During the post-transition period, however, there would be annual savings of $5,000,000 (or less than 1 percent) because of decreased design costs.

The long-run advantages cited by BPR resulting from metrication under Assumption III are the same as those cited under Assumption II. Similarly, the advantages of metrication under Assumption III would outweigh the disadvantages, because of the standardization of modular units.

All other impacts under Assumption III are nearly identical to those cited under Assumption II.

6. Conclusion. BPR believes that there should be concerted action in the United States to bring about metrication in measurement units and engineering standards. The respondents suggest action to acquaint the U.S. population with metric language. With regard to units, the respondents believe that there should be a program of making changes as soon as possible in those areas where there are no large costs, followed by changes in more difficult areas.

Impacts of Metrication on Highway Transportation

Present Metric Usage. The metric system is used in less than one-quarter of all field activities in the automobile industry and in highway planning. The highway field currently works in various measurement systems; e.g., chains, feet, rods, acres, stations (surveying); feet, decimal feet (surveying, design); yards, feet, inches (pavements, concrete form work); and metric system (theoretical research, materials testing). There appears to be no trend toward further metric usage. The impact of the increasing worldwide and domestic metric usage on the automobile industry and on highway planning has been *negligible.*[7] For example, while there is international exchange of highway technology, the product is not exportable or importable.

Future Impacts of Metrication. Assuming no concerted national action to increase metric usage, the impacts of the increasing worldwide and domestic metric usage on highway transportation will be *negligible*. Under this assumption, there will be little change in present conditions with regard to metric usage in highway planning or safety activities.

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[7] See "Classification of Intensities of Impact" scale on p. 79.

If there were a planned national program to increase metric usage, metrication would have wide impacts on highway planning. Highway plans and standards would have to be changed; engineering equipment recalibrated; highway signs (mileage, speed) changed to metric;[8] odometers and speedometers calibrated to metric, etc.

The problem of metrication is not in the technical feasibility, but rather in defining the costs and resulting benefits, neither of which are simple tasks.

During the conversion period, metrication would impair the effectiveness of FHWA in carrying out its responsibilities. However, in the long run, there would be little or no impact on the FHWA's effectiveness. The impact of the increasing metric usage on the ability of FHWA to perform its mission would be *trivial.*

What Action Should Be Taken? In view of the worldwide tendency toward metric usage, the FHWA supports conversion to the metric system, although at present it is "not actively promoting it".

FEDERAL RAILROAD ADMINISTRATION (FRA)

Liaison Representative:

Kenneth L. Lawson, Chief, Rail Technology Division

Respondents — Internal Operations:

1. Bureau of Railroad Safety
2. Engineering, Research and Development Division, Office of High Speed Ground Transportation

Respondent — Railroad Transportation Area of National Responsibility:

1. Office of High Speed Ground Transportation

Respondent — Railroad Safety Area of National Responsibility:

1. Engineering Branch, Bureau of Railroad Safety

1. Mission of the Federal Railroad Administration. The general purpose of the Federal Railroad Administration is to consolidate Government support of rail transportation activities, to provide a unified national policy, to conduct research and development activity in support of improved rail transportation and its future requirements, and to serve as the principal organization for assistance to the Secretary of Transportation on all matters relating thereto.

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[8] With regard to highway signs, for example, a BPR estimate shows a net cost of about $30 million (one-time cost) to replace the approximately 950,000 highway signs along both sides of the 3,300,000 miles of highways in the United States (not including city streets). This dollar figure does not include the cost of replacing the innumerable signs along city streets (e.g., signs showing bridge clearances or speed limits). As the law now stands, the DOT itself would not pay the cost of replacing highway signs even on the Interstate Highway System. On the interstate system, replacement of highway signs is a maintenance expenditure; this type of expenditure normally is borne by the State.

The principal programs of the Administration are railroad safety, high speed ground transportation, and The Alaska Railroad. The Bureau of Railroad Safety and the Office of High Speed Ground Transportation are respondents in this Survey. The Bureau of Railroad Safety administers and enforces specific Federal Statutes relating to common carriers engaged in interstate commerce by railroad. The Bureau inspects railroad and related industry equipment and records, reviews required reports, and investigates accidents. Specific responsibilities include locomotives, safety devices, safety appliances on railroad cars and engines, power brakes on trains, signals and controls on the operation of trains; safety regulations for rail and pipeline transportation of hazardous material; and compliance reviews of hours of service and rest periods of employees connected with the movement of trains. The Bureau also investigates and issues reports concerning collisions, derailments, and other railroad accidents resulting in serious injury to persons or to property of a railroad.

The Office of High Speed Ground Transportation plans and implements a program of research, development, and demonstration in high speed ground transportation.

2. Extent of Present Metric Usage. At present, only the Research and Development Division of the Office of High Speed Ground Transportation (OHSGT) uses metric units in any of its activities. Metric units are used only in those activities involving tracked air cushion vehicles (TACV). The TACV designs are in dual units for purposes of international cooperation and commerce and because the scientific community prefers metric units. The French have done substantial development work on TACV's (almost exclusively in metric units). The advantages of present usage outweigh the disadvantages.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Under this assumption, neither respondent anticipates any changes toward metrication. Both the Bureau of Railroad Safety and OHSGT foresee problem areas, however, if their subdivisions do not make changes toward further metric use. There will be intensified problems of international cooperation, of conversion from one system to the other, and of interfacing between the two systems.

4. Anticipated Impact Under A Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). OHSGT expects added costs for some activities and savings for other activities during the transition period. There would be no net cost impact. During the post-transition period, there would also be added costs for some activities and savings for other activities, but no net cost impact. The Bureau of Railroad Safety does not anticipate any cost impacts under either the transition or post-transition periods.

The Bureau of Railroad Safety and OHSGT agree that long-term advantages, but no long-term disadvantages, would result. They cite operational improvement, easier promotion of U.S. standards internationally, and improved international communication as advantages. In addition, OHSGT believes that there would be long-term cost decreases.

In order to implement the changeover, the Bureau of Railroad Safety would have to obtain new equipment and conversion tables. OHSGT would require its contractors to prepare plans in metric units. OHSGT would also change units on existing drawings and obtain conversion tables.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). According to the respondents the impacts of metrication under this assumption would be identical to those described under the prior assumption, except that there would be a $50,000 annual savings during the *post-transition* period for OHSGT.

6. Conclusion. Both respondents at the Federal Railroad Administration favor a concerted program of metrication in both measurement units and engineering standards. A 5-year transition period is preferred over a 10-year period.

Impacts of Metrication on Railroad Transportation

Present Metric Usage. The metric system is used in no significant work activities within American railroads. There appears to be no trend toward metric usage.

Future Impacts of Metrication. Assuming that there will be no concerted national action to increase metric usage, the American railroads will not adopt the metric system within any of their activities. There will be no impact on the FRA from the increasing worldwide and domestic metric usage.

If there were a nationally planned program to increase metric usage, there would be increased inventory costs during the changeover period for the railroads. The difficulties would continue for the duration of the conversion period. Because of this, a short changeover period would be preferred by the railroads. Adoption of the metric system in the United States would slightly improve the effectiveness of the FRA within its area of responsibility over the long term; however, its short-term effectiveness would be impaired.

What Action Should Be Taken? The operation of the American railroads would not be affected appreciably one way or the other by metrication. Therefore, if there is to be a conversion to the metric system, it should be done in as short a time as possible.

Impacts of Metrication on Railroad Safety

Present Metric Usage. The metric system is not used by American railroads for their safety activities, and there is no trend toward metric usage. There has been no impact on railroad safety from increasing worldwide and domestic metric usage.

Future Impacts of Metrication. Assuming no concerted national action to increase metric usage, the railroads will not adopt the metric system in any of their safety activities, and there will be negligible impact on railroad safety from the increasing worldwide and domestic metric usage.

If there were a nationally planned program to increase metric usage, the effects on railroad safety would be negligible. However, adoption of the metric system would improve the effectiveness of the FRA in dealing with its responsibilities over the long run; in the short run, there would be some additional workload. All in all, the impact on the FRA's ability to perform its mission with respect to railroad safety would be *negligible.*[9]

What Action Should Be Taken? The FRA would like to see increasing metric usage within its railroad safety area of responsibility.

URBAN MASS TRANSPORTATION ADMINISTRATION (UMTA)

Respondents—Urban Mass Transportation, Environmental Pollution Control, and Safety Areas of National Responsibility:

1. Director, Special Projects
2. Director, Research Branch

The UMTA (1) assists in the development of improved mass transportation facilities, equipment, techniques, and methods with the cooperation of both public and private mass transportation operators; (2) encourages the planning and establishment of areawide urban mass transportation systems needed for economical and desirable urban development, with the cooperation of both public and private mass transportation operators; and (3) provides assistance to State and local governments and their instrumentalities in financing such systems, to be public or private as determined by local needs.

Impacts of Metrication on Urban Mass Transportation[10]

Present Metric Usage. The metric system is used in less than one-quarter of all work activities in the urban mass transit field and there seems to be no trend toward further usage. The increasing worldwide and domestic metric use has had *negligible* impact on the urban mass transit field. The United States has few foreign markets for urban transportation equipment and makes relatively small purchases that would be affected by the metric system.

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[9] See "Classification of Intensities of Impact" scale on p. 79.

[10] The UMTA was asked to supply information on the environmental pollution control and safety areas over which it has responsibility. The impacts on these two areas from the standpoint of UMTA would be similar to those described with regard to the transportation area of responsibility.

Future Impacts of Metrication. Assuming that there will be no concerted national action to increase metric usage, there will be little effect from the increasing worldwide metric usage on the urban transit field in the United States. Actually, purchases from foreign countries using the metric system will probably become more complicated and more expensive.

If there were a planned national program to increase the use of the metric system over a 10-year period, conversion would be tremendously complicated in the transit field. Transportation equipment has a life expectancy of greater than 10 years. A 20-year transition period would enable equipment to be replaced with fewer difficulties and costs.

Adoption of the metric system would certainly impair (at first) the effectiveness of the UMTA in dealing with its areas of responsibilities. Over the long term, however, metric standards should simplify manufacturing, procurement and dealings with foreign suppliers. Other than this simplification, the ability of the UMTA to perform its mission would not be affected.

What Action Should Be Taken? The UMTA feels that the U.S. transit industry is not one of the major elements in a decision on whether the United States should go metric. For the long term, conversion would be "nice to do" to keep the industry in harmony with other facets of the economy. Since metrication does offer some long term advantages, conversion which could occur as systems are replaced or tooling is changed would seem attractive to the urban transit industry and to the UMTA from the standpoint of administering the various UMTA programs.

NATIONAL HIGHWAY SAFETY BUREAU

Respondent — Highway Safety Area of National Responsibility:

1. Deputy Director for Technology

1. Mission of the National Highway Safety Bureau. Originally the Bureau was organized as a component part of the Federal Highway Administration. On March 22, 1970, it was separated from the Federal Highway Administration and became a separate operating administration of the Department of Transportation, reporting directly to the Secretary. The Bureau carries out those portions of the highway safety program relating to motor vehicles and drivers under the National Traffic and Motor Vehicle Safety Act of 1966 and the pertinent provisions of the Highway Safety Act of 1966.

The National Highway Safety Bureau was established to carry out a congressional mandate to reduce the mounting number of deaths and injuries resulting from traffic accidents on the Nation's highways. In accordance with these national goals the National Highway Safety Bureau provides leadership to and coordination of programs to improve the safety of motor vehicles and components, pedestrian safety through education, and the problems of driver behavior that relate to safety.

Impacts of Metrication on Highway Safety

Present Metric Usage. The metric system is used in less than one-fourth of all activities in the highway safety field. There is some increased awareness of metric dimensions and specifications due to the growing influence of foreign cars in the U.S. economy. The impact of this increasing metrication has had a substantial impact on highway safety because: (1) dual dimensioning of engineering drawings and specifications has created major problems and (2) the increasing proportion of foreign (metric measure) cars in the U.S. vehicle population creates parts and hand tool problems in the repair and service industry.

Future Impacts of Metrication. Assuming no concerted national action to increase metric usage, serious problems in compatibility of replacement parts, design and test specifications, and all types of service tools will continue.

If a smooth changeover to the metric system is to be accomplished, a nationally planned program is essential. A 10-year period would probably be too short in view of the massive impact to the American economy of any changes to the motor vehicle. However, metrication should be feasible in less than 20 years. The benefits of metrication would be significant. However, major difficulties and changeover pains would add to both government and industry workload during the transition period.

Metrication would greatly assist foreign auto manufacturers in penetrating U.S. markets, probably more so than with most other consumer products, since service and repair considerations can influence auto buying attitudes significantly. Today many consumers may refuse to buy a foreign car because they know their corner gas station cannot service it properly.

Adoption of the metric system in the United States would improve the effectiveness of the National Highway Safety Bureau within its area of responsibility. Once metric standardization has been achieved, uniform specifications can be used for all vehicles (foreign and domestic) in setting performance requirements and compliance limits. During the transition period, there would be a *substantial* impact on the ability of the Bureau to perform its mission. Major operational problems and increased workloads would exist in areas of technical standards and specifications.

What Action Should Be Taken? The influence of the automobile permeates the American social, economic, and political structure. Metrication in this area would bring major benefits in product and service standardization; but the enormous impact of even small changes must be carefully calculated (e.g., the "simple" task of changing from customary to metric units on roadsigns). Because of these factors, a carefully planned national program is required. Major economic impacts must be considered in advance and handled properly. The Bureau believes that, ultimately, metric standardization benefits would be worth the effort.

NATIONAL TRANSPORTATION SAFETY BOARD (NTSB)

Respondent — Automobile Safety Area of National Responsibility:

1. Bureau of Surface Transportation Safety

The NTSB has the authority to investigate, determine the probable cause, and issue reports on all civil aviation accidents; make final cause determination and report the facts and circumstances of major surface transportation accidents, relying on the Administration within the DOT to investigate such surface accidents; and to make recommendations for the purpose of preventing accidents and promoting safety in transportation. The NTSB also conducts special transportation safety studies, examines the adequacy of transportation safety standards, and determines compliance with these standards, and reviews on appeal actions against any certificate or license issued by the Secretary or an Administrator of the Department of Transportation. The NTSB is independent of the Secretary and other offices and officers of the Department.

The NTSB does not have any responsibility for the preparation or issuance of standards or specifications. Therefore, the problems of adaptation or conversion should be minimal. Nevertheless, the Board's functions will be affected by any degree of metrication because:

a. Investigation and determination of cause of transportation accidents necessarily involve detailed consideration of a myriad of dimensions, weights and measures of the vehicles, pathways, and environments analyzed;
b. Constant reference is made to textbooks, blueprints, manuals, regulations, and design criteria; and
c. All operating instructions, charts, sketches, guidelines, etc., are presently based upon the U.S. system of measurements.

Impacts of Metrication on Automobile Safety

Present Metric Usage. The metric system is used in less than one-quarter of all work activities in the automobile safety field. The only trend toward further metric usage has been limited to foreign-built vehicles, which represent approximately 5 percent of highway vehicles in the United States. The impact on the automobile safey area from the increasing worldwide and domestic metric usage has been *negligible.* [11] Since NTSB is not a regulatory agency, the only effects on NTSB are in the review of vehicle plans (in metric system) in those instances where foreign-built vehicles are involved. There has been no impact on the Safety Board's ability to perform its mission.

Future Impacts of Metrication. Assuming no concerted national action to increase metric usage, there will be no effects on automobile safety or on NTSB's activities.

If there were a concerted national program to increase metric usage, certain changes would be required in manuals, data, plans, specifications, and all measurements in transportation systems. Minor difficulties could be expected to hamper investigators during the conversion period. The length of the conversion period would have very little effect upon the Safety Board's activities. Some impairment of effectiveness would result initially; however, after adoption by industry, there would be no adverse effects from metrication on the automobile safety activities.

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[11] See "Classification of Intensities of Impact" scale on p. 79.

What Action Should Be Taken? In view of the relatively minor effect on the Safety Board as compared to industry and U.S. government regulatory agencies, NTSB believes that the Board is not in a position to comment in respect to metrication.

ATOMIC ENERGY COMMISSION (AEC)

Liaison Representative:

Frederick J. Shon, Assistant Director for Nuclear Facilities, Division of Operations Safety

Respondents — Internal Operations:

A. In-House

1. Nevada Operations Office
2. Burlington AEC Plant
3. Division of Isotopes Development
4. Division of Reactor Standards
5. Division of Contracts, Headquarters
6. Fallout Studies Branch, Division of Biology and Medicine
7. Engineering Branch, Division of Construction
8. Transportation Management Branch, Division of Construction
9. Staff Communications Branch, Division of Construction
10. Naval Reactors Division
11. Production Division
12. Raw Materials Division
13. Division of Reactor Development and Technology
14. Research Division
15. Space Nuclear Systems Division
16. Office of Safeguards and Materials Management

B. Contractors:

17. Los Alamos Scientific Laboratory
18. Sandia Laboratories
19. AEC Albuquerque Operations, Bendix, Kansas City Division
20. Rocky Flats Division, Dow Chemical Company
21. Mound Laboratory, Monsanto Research Corporation
22. Pantex Plant, Mason and Hanger, Silas Mason Company, Inc.
23. Pinellas Peninsula Plant, Pinellas Area Office, General Electric Company
24. Lawrence Radiation Laboratory, University of California

Respondent — Atomic Energy Area of National Responsibility:

1. Division of Reactor Development and Technology

Respondent — Environmental Pollution Control Area of National Responsibility:

1. Pollution Control Branch, Division of Operations Safety

1. Mission of the Atomic Energy Commission. The AEC administers and encourages private participation in programs in research and development, international cooperation, production of atomic energy and special nuclear materials, and the dissemination of scientific and technical information. The Commission has responsibility to protect the health and safety of the public; and to regulate the control and use of source, by-product, and special nuclear materials.

Thus, the Commission is charged with two basic responsibilities: to develop nuclear energy and to regulate its use. Both responsibilities are likely to be affected by metrication.

2. Extent of Present Metric Usage. All 24 of the responding AEC subdivisions use the metric system. Most activities in electronic and chemical engineering and nuclear science and nuclear engineering use the metric system. Mechanical engineering activities in AEC are largely in the customary system, but not entirely. Plant Engineering uses the customary system almost exclusively.

Following are examples of AEC operations in which the metric system is used: measurement of radioactivity and radiation; sales and leases of nuclear materials; sales of uranium enrichment services; contracts involving construction of reactors; regulations governing the packaging and transportation of radioactive materials; reactor core physics; receiving and shipping weights of isotopes; laboratory studies in geophysics, geochemistry and metallurgical treatment of uranium bearing materials; quantities of special nuclear materials and radioistopes; and, heat treating processes. Nuclear energy is one of the few technological fields that has sprung directly from the pure sciences. Since metric units are the basic language of pure physics and chemistry, most materials peculiar to the nuclear industry are already measured in metric units. Special nuclear and by-product material (fissile fuels and radioisotopes) are bought and sold in metric units. By coincidence, electrical energy, production of which is a major commercial application of nuclear science, is also dealt with in metric units.

Therefore, measurement units in the nuclear field, where such measurements pertain to things used *only* in the nuclear field, are generally metric. Standards peculiar to the field (e.g., radiation standards) are also metric, as a rule.

There are, however, many units and standards currently in use in nuclear technology which pertain to matters not exclusively nuclear. Thus, although a nuclear power plant may be fueled with a number of kilograms of uranium, and may produce a certain number of kilowatts of power, there may be many pumps in the plant rated in gallons per minute, many pipes and valves specified in standard inch modules, and many gauges in degrees Fahrenheit.

Customary and metric systems are used together in uranium ore processing operations. Usually laboratory measurements are in metric units while production operations measurements are in customary units.

Research reactors may produce fluxes of neutrons measured in neutrons per square centimeter per second to irradiate milligrams of special materials. At the same time, they may discharge their waste heat through heat exchangers rated in BTU per hour.

Obviously, if one system of units were used throughout, the industry would benefit in clarity of communication and simplicity of engineering description. The chief benefit to this particular industry would, in fact, be the elimination of repeated changes from one system to another in each individual endeavor. The chief disadvantage of conversion to metric units of measurement would be in the changing of prior records and reports.

Changing to metric engineering standards and modules presents quite another set of considerations. Although, nuclear materials are measured in metric units, most large scale equipment typical of nuclear plants is built to ABC (American-British-Canadian) dimensions. Pipes, valves, tanks, and their fastenings are usually in nominal inch sizes. And, of course, buildings are constructed to nominal foot dimensions, with standard structural members in customary sizes.

It is evident, then, that though materials which are peculiarly nuclear are measured in metric units, major nuclear engineering installations, as is the case with major engineering installations of all kinds in the United States, use customary units. No real trend in either direction is currently discernible, and barring action by other parts of the economy, it is likely that the nuclear field will continue to straddle the metric-customary fence, measuring its own products in metric units and ordering its equipment in customary sizes. Most of the responding subdivisions believe that the advantages of the present metric usage in AEC outweigh disadvantages.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Under this assumption, only four groups say that they would change and only one (the Space Nuclear Systems Division) expects almost total use of metric units, though not of metric engineering standards, in design studies and performance analyses by 1975. The reasons for change are the uniformity and consistency which the metric system would lead to in a world of increasing metric usage. There would be slight added costs (under 1 percent) for a short time because of the lack of use of metric units in certain engineering disciplines. The Division of Isotopes Development, the Transportation Management Branch in the Construction Division, and the Fallout Studies Branch do not specify anticipated changes toward increased metric usage.

If respondents make no change toward metric units and/or engineering standards under Assumption I, most expect problems to result because of the increasing metric usage outside of AEC. Problems mentioned most often are: dual dimensioning, increased conversion, increased interfacing, and difficulties in international cooperation.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption, most subdivisions expect cost increases, especially during the transition period (one expects a savings during the transition). Most of these groups, however, who believe they can estimate cost increases think they would be small; only the Division of Naval Reactors expects its cost increase to exceed 10 percent. All agree that the main expenditure would be during transition, and only two (contractors supplying special devices for the Division of Military Application) believe there would be much chance to recoup the money spent through later savings. In most cases, estimated costs in both the transition and post-transition are gross approximations.

The Division of Isotopes Development expects a savings of $500,000 annually, or 5 to 10 percent, because of the elimination of conversion activities and problems.

Those who expect cost increases during the *transition* period of under 1 percent are:

a. Nevada Operations Office—an annual cost increase of $250,000: $75,000 for engineering, $62,500 for design, $62,500 for construction, and $50,000 for maintenance.
b. Burlington AEC Plant—an annual cost increase of $10,000 for its operations as a whole.
c. Division of Construction (Engineering Branch)—an annual increase of $19,000: $15,000 for revising engineering and construction criteria, and $4,000 for updating reference materials.
d. Production Division (no activities or costs specified).
e. Space Nuclear Systems Division—an annual cost increase of $50,000 in space nuclear power and propulsion areas.
f. Division of Reactor Development and Technology—an annual cost increase of $1 million for retraining and recalibrating.
g. Sandia Laboratories—an annual cost increase of $95,000: $30,000 for design, $20,000 for fabrication, $20,000 for inspection and $25,000 for training activities.
h. Dow Chemical (Rocky Flats Division)—an annual cost increase of $79,000: $29,000 for manufacturing, $20,000 for research and development and $30,000 for services activities.
i. Mason and Hanger—Silas Mason Co., Inc. (Pantex Plant)—an annual cost increase of $10,000: $5,000 for training and $5,000 for conversion activities.
j. Lawrence Radiation Laboratory—an annual cost increase of $50,000 to $100,000 assuming a 10-year period for comparability. Actually the total transition costs would be $500,000 to $1 million over a 20-year period.

Those who expect transition cost increases of 1 to 5 percent are:

a. Bendix (Kansas City Division)—an annual cost increase of $90,000: $15,000 for design, $30,000 for manufacturing, $25,000 for inspection and $20,000 for training activities.
b. General Electric Company (Pinellas Peninsula Plant)—an annual cost increase of $220,000: $30,000 for specifications, $50,000 for materials, $20,000 for production, $100,000 for equipment, and $20,000 for facilities activities.

Those groups who expect cost increases of 5 to 10 percent during the transition are:

a. Division of Construction (Staff Communications Branch)—an annual cost increase of $10,000 for administration and operations.
b. Monsanto Research Corporation (Mound Laboratory)—an annual cost increase of $300,000: $200,000 for production and $100,000 for research and development activities.

The Naval Reactors Division expects a cost increase of over 10 percent during the transition period because of an annual increase of $5 million for its operations as a whole.

The eight remaining groups expect no cost impacts during the transition period.

During the post-transition period, five respondents expect savings, and four expect cost increases. The remaining 15 respondents expect no cost impacts during the post-transition period.

The following respondents expect savings during the post-transition period:

a. Division of Production—a cost savings of less than 1 percent.
b. Division of Isotopes Development—a cost savings of $500,000 annually, or 5 to 10 percent, due to elimination of conversion activities and problems.
c. Space Nuclear Systems Division—an annual cost savings of $150,000 or 1 to 5 percent.
d. Sandia Laboratories—an annual savings of less than 1 percent, or $100,000 for design work.
e. Monsanto (Mound Laboratory)—an annual savings of less than 1 percent: $100,000 in production, and $50,000 in research and development activities.

The following expect cost increases during the post-transition period:

a. Staff Communications Branch of the Division of Construction—a cost increase of 1 to 5 percent because of an annual cost increase of $2,000 for administration and operations.
b. Naval Reactors Division—increased costs of 5 to 10 percent because of a $1 million annual increase for operations as a whole.
c. Bendix (Kansas City Division)—a cost increase of less than 1 percent because of annual added costs of $10,000 for manufacturing and $10,000 for inspection activities.
d. Dow Chemical Company (Rocky Flats Division)—a cost increase of less than 1 percent because of annual added costs of $10,000 for manufacturing.

All responding groups except for the Naval Reactors Division see long-term advantages in the metrication of measurement units. Long term advantages most often cited are improved international cooperation (due to universal standardization) and operational improvement. Operational improvement would result from improved communications between scientists and others, simplification of calculations, elimination of the dual system, less confusion, and fewer errors because the metric system would simplify design calculations, drafting, machine shop work, and shop fabrication. Present operations which require conversion of scientific information from metric to customary units would benefit considerably. Facilitated promotion of U.S. standards internationally is often cited as a long-term advantage primarily because it would help U.S. balance of payments. Nine respondents believe that in the long run, there would also be cost decreases resulting from metrication of measurement units.

Only three of the 24 groups foresee long-term disadvantages. The Naval Reactors Division and Bendix (Kansas City Division) believe that there would be cost increases and operational impairment. The Pinellas Peninsula Plant of General Electric expects cost increases over the long term.

Most groups in AEC believe that long-term advantages would outweigh disadvantages, at least in non-fiscal terms. Fifteen believe that advantages of metrication of measurement units would outweigh disadvantages. Only four believe that the advantages would not outweigh disadvantages: the Burlington AEC Plant, Staff Communications Branch of the Division of Construction, Naval Reactors Division, and Bendix (Kansas City Division).

The Burlington AEC Plant believes that costs would be increased without any apparent offsetting advantages. The Staff Communications Branch says that in its activities there are insufficient international communications requirements to make international compatability necessary. The Naval Reactors Division believes the problems of metrication would be too great for advantages to predominate. Bendix believes that a change in language only would lead to confusion and errors. But, Bendix also believes that the advantages of metrication in both units *and* standards would outweigh the disadvantages (see under Assumption III).

Twelve of the 24 responding groups in AEC identify specific problems, aside from the costs of changeover. None foresees major problems in the changeover of measurement units, especially if historical records do not have to be changed. The chief problem would be in the retraining of personnel. There would also be operational problems such as human resistance to change, the use of a dual system, loss of time spent in conversions, loss of time and material because of an increase in errors, and confusion. Problems would be caused because not all elements of the industrial complex would change on the same time schedule. There would also be problems of equipment maintenance.

In order to implement a changeover, the AEC believes it would have to establish training programs, revise internal drawings, convert product and facility specifications from customary to metric, obtain some new equipment or modify existing equipment, recalibrate some instruments, and make some changes in AEC handbooks. Design standards and repair parts documentation would have to be revised. Standards and codes would require translation from within and outside of AEC. A directive ordering the changes to

AEC in-house operations and a simple provision in contracts would handle most changes under Assumption II.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). Aggregate cost impacts under this assumption are not significantly different than under the prior assumption, although several subdivisions are impacted much more heavily under Assumption III. Eleven responding groups cite different cost impacts under Assumption III than under the prior assumption. Only these groups are cited below.

During the transition period, the three following groups expect cost increases of less than 1 percent:

a. Lawrence Radiation Laboratory—an annual cost increase of $80,000 to $120,000 based on a 10-year period for comparability. Actually, the total cost would be $800,000 to $1,200,000 over a 20-year transition period.
b. Bendix (Kansas City Division)—an annual cost increase of $60,000: $15,000 for design, $20,000 for manufacturing, $15,000 for inspection, and $10,000 for training activities.
c. Dow Chemical Company (Rocky Flats Division)—an annual cost increase of $318,000: $228,000 for manufacturing, $40,000 for R&D, and $50,000 for services activities.

The following six responding groups expect a cost increase of 1 to 5 percent:

a. Nevada Operations Office—an annual cost increase of $500,000: $150,000 for engineering, $125,000 for design, $125,000 for construction and $100,000 for maintenance activities.
b. Burlington AEC Plant—an annual cost increase of $300,000 for its operations as a whole.
c. Space Nuclear Systems Division—an annual cost increase of $500,000 for its operations as a whole.
d. Mason and Hanger—an annual increase in costs of $321,000: $20,000 for equipment, $1,000 for raw stock, and $300,000 for dimensioning, time, and materials loss for dual system.
e. Pinellas Peninsula Plant of General Electric—an annual cost increase of $260,000: $40,000 for specifications, $60,000 for material, $30,000 for product, $110,000 for equipment and $20,000 for facilities activities.
f. Los Alamos Scientific Laboratory—an annual cost increase of $400,000 for replacement or modification of equipment and inventory.

The Mound Laboratory of the Monsanto Research Corporation estimates a cost increase of 5-10 percent: $400,000 for production and $100,000 for R&D activities. Finally, the Naval Reactors Division expects an annual increase in costs of over 10 percent because of the annual cost increase of $6 million for its operations as a whole.

Cost impacts during the post-transition period under Assumption III would be nearly the same as those described under Assumption II. Only five respondents believe that the costs impacts would be significantly different under the two assumptions.

The Space Nuclear Systems Division expects an annual cost savings of $1,250,000 or 5 to 10 percent during the transition period; under the prior assumption, anticipated cost savings are $150,000 or 1 to 5 percent. Bendix (Kansas City Division) expects annual savings of under 1 percent during the post- transition: $5,000 for manufacturing and $5,000 for inspection activities. Under the prior assumption, Bendix anticipated a cost *increase* during the post-transition period, instead of a savings. The Los Alamos Scientific Laboratory expects a small savings during the post-transition period; under Assumption II, the Laboratory expects no cost impact during the post-transition.

The Dow Chemical Company (Rocky Flats Division) expects a cost increase of 1 percent during the post-transition because of an annual added cost of $50,000 for manufacturing activities. Under Assumption II, the added cost during the post-transition would be only $10,000 for manufacturing activities. The Naval Reactors Division estimates a cost increase during the post-transition of 5 to 10 percent or $1,500,000 annually for its operations as a whole; under Assumption II, the Division expects an annual cost increase of $l million during the post-transition period.

Under Assumption III long-term advantages and disadvantages are virtually identical to those described under Assumption II. The significant exception is that there would be the potential for worldwide greater interchangeability of parts under Assumption III because of long range unification and standardization of engineering standards internationally. A less significant advantage occurring under Assumption III, but not under Assumption II, would be the potential for a system of more realistic nominal sizes and subdivisions thereof. Also, the production community would relate to the scientific community more accurately. Bendix (Kansas City Division) believes that under Assumption III, long range cost decreases and operational improvements would result; but under Assumption II, there would be cost increases and operational impairments.

The advantages of metrication in both units and engineering standards would outweigh disadvantages according to 16 responding groups. The advantages would not predominate, according to three groups (Burlington AEC Plant, Staff Communications Branch of the Division of Construction, and the Naval Reactors Division).

Problems of metrication under Assumption III are somewhat more complex than they are under Assumption II. Metrication in engineering standards would raise significant problems involving replacement parts and modifications of existing equipment. There would be difficult interfacing problems between metric and non-metric equipment. Los Alamos Scientific Laboratory says that the mixture of U.S. and metric machines during and following the transition period would require careful training and supervision of craftsmen and may lead to many errors of interpretation.

In order to implement the changeover, AEC says it would have to rewrite and reissue many engineering standards. Several subdivisions and contractors would have to make substantial investments in purchasing new or modifying existing equipment and instruments. Dual inventories of some items would have to be established. This would create the need for more storage capacity. For example, fabricated items are designed to utilize stock sizes of tubing, rod and sheet materials, so both customary and metric stock would have to be maintained until the older machines were retired. The period of duality could be shortened by an accelerated replacement of fabrication equipment, but this would be rather expensive, particularly since customary-sized equipment would have a very low trade-in value. Changes in building codes would also be required in some cases.

The Los Alamos Scientific Laboratory (LASL) mentions a high inventory of machine tools worth about $20 million built according to customary standards. LASL points out, however, that conversion kits could probably be developed to make such machines convenient for metric use at a fraction of the cost of replacement. The Mound Laboratory of Monsanto has a much smaller inventory (worth about $3 million) of machine tools to convert.

In most AEC divisions, there would be little significant difference between problems and implementation procedures under Assumption III and under Assumption II since actual production activities are carried out by contractors.

6. Conclusion. In general, AEC responding groups are favorable to a concerted move toward the metric system in both units and engineering standards. Fourteen[1] of the 24 groups favor a concerted program of metrication; one (Burlington AEC Plant) does not favor a concerted program; seven[2] do not know; and two provide no answer since they do not deem it necessary to reply (Research Division and Office of Safeguards and Materials Management) because they already operate on the metric system.

Bendix (Kansas City Division) believes that in a concerted program of metrication, a change to metric units without a corresponding change to metric engineering standards and conversion of equipment scales and gauges would prove to be highly confusing.

The following types of concerted action are suggested: Federal legislation, public education, training of employees and clients, a program of cooperation with industry and trade associations by the Government, and required implementation by Government agencies for government-sponsored programs. Other suggested measures include: dual labeling of consumer goods, tax incentives, revision of laws relating to units and standards, and the use of dual terminology in laws and codes. The Division of Isotopes Development would like to see a 10-year metrication schedule with enough flexibility to avoid unusual costs. The Division of Regulation believes that legislation must be enacted prior to any action toward metrication.

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[1] These are: Nevada Operations Office, Division of Isotopes Development, Division of Reactor Standards, Fallout Studies Branch, Transportation Management Branch of the Division of Construction, Production Division, Space Nuclear Systems Division, Los Alamos Scientific Laboratory, Sandia Laboratories, Bendix (Kansas City Division), Dow Chemical Company (Rocky Flats Division), Monsanto (Mound Laboratory), Pinellas Peninsula Plant of General Electric, and Lawrence Radiation Laboratory. It is significant that all the responding AEC contractors except for Mason & Hanger (Pantex Plant) favor concerted action.

[2] These are: Division of Contracts, Engineering Branch and Staff Communications Branch of the Division of Construction, Naval Reactors Division, Raw Materials Division, Division of Reactor Development and Technology, and Mason & Hanger (Pantex Plant).

Some people advocate a directive for government supported activities to shift to the metric engineering system. The Los Alamos (LASL) respondent believes that such a directive without full participation by industry would produce chaos. Any international agreements which already exist concerning metric standards and practices for fabrication and stock sizes would need to be ratified by both government and industry. The translation of codes and standards to metric units would then be a major but straightforward task. "It seems unlikely that the latter could be accomplished without specific subsidization by the government, since the country is already in some difficulties in keeping codes in step with modern materials and processes. It also seems undesirable to AEC to undertake actual production of hardware until the above steps have been taken. The costly process of retooling could then be undertaken." It is not clear to the LASL respondent that sufficient incentives can be provided to industry to undertake the program on a voluntary basis but at the same time it seems essential that there be a concerted effort on a planned schedule if the job is to be done.

Most groups believe that a 10-year transition period would be satisfactory. Most feel that there would be little net advantage to be gained from expanding or compressing the transition period. The Nevada Operations Office believes that a 10-year transition period would be satisfactory for units only, but that a 15-year period would be better if standards were changed also. The Space Nuclear Systems Division believes that a 5-year transition period would be better for units only, but that a 10-year period for changing standards would be the minimum required.

In summary, AEC believes that concerted metrication would be a good move, that costs would be largely in non-nuclear areas, that costs would not be directly recouped, and that 10 years is a reasonable transition period.

Impacts of Metrication on Atomic Energy

Present Metric Usage. At present, the metric system is used in less than one-quarter of all work in the energy field over which the AEC has cognizance. Metric usage is increasing slightly. The American Society for Testing and Materials (ASTM), for example, has started incorporating SI equivalents in all new revisions of ASTM standards. This involves no change in the engineering standards but does provide for dual measurement units.

Increasing metric usage has had *trivial*[3] impact on the AEC's energy field, because there has been virtually no increase in the domestic use of SI units in the industrial areas of concern. There has also been only *trivial* impact on the ability of the AEC to perform its mission.

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[3] See "Classification of Intensities of Impact" scale on p. 79.

Future Impacts of Metrication. If there were concerted national action to increase the use of the metric system, the impacts would strike the AEC only indirectly. Additional costs in the regulatory staff would be minimal when compared to the costs to be incurred by the nuclear industry. Further, the impacts on the nuclear industry would be largely those reflected from other industrial efforts. As may be gathered from the aforesaid, effects on the nuclear industry, insofar as it is strictly nuclear, would be *trivial.* Cost effects, for AEC and others in the field, would stem from increased costs to manufacturers of large equipment.

What Action Should be Taken? The AEC says that as a general rule it would seem to make sense to use a single worldwide system of weights and measures. Since the nuclear industry depends upon many other industries, including construction, chemical equipment, steam power equipment, plumbing, piping, and electronics, AEC does not believe it can estimate the impact upon all industries involved, or evaluate independently the sum of the individual effects.

Impacts of Metrication on Environmental Pollution Control

Present Metric Usage. The metric system is used in over three-quarters of all work activities in the pollution control field with which AEC deals. There is a trend toward even greater, if not complete, metric usage. The bulk of measurement and recording is already done in the metric system. The impact of the increasing metric usage on the environmental pollution control field which AEC deals with has been *trivial.* In general, those directly concerned with environmental pollution control have had little difficulty converting to the metric system. Minor replacements of measuring devices, changes in containers, and trivial changes in labeling and conversion of units have been the only impacts.

Future Impacts of Metrication. A program of concerted national action in the United States to increase the use of the metric system would improve the AEC's effectiveness in dealing with its responsibilities in the pollution control field. Metrication would improve the data handling, processing and calculating activities.

What Action Should Be Taken? "Impact of metrication would be *trivial* and metrication according to a nationally planned program would probably be welcomed by all concerned."

CIVIL AERONAUTICS BOARD (CAB)

Liaison Representative:

Allan Craig, Director, Bureau of Accounts and Statistics

Respondent—Internal Operations:

1. Bureau of Accounts and Statistics

Respondent—Air Transportation Area of National Responsibility:

1. Bureau of Accounts and Statistics

1. Mission of the Civil Aeronautics Board. The CAB has economic regulatory powers over civil aviation within the United States and between the United States and foreign countries. The Board grants authorizations to carriers to engage in interstate and foreign air transportation. It issues permits to foreign air carriers authorizing them to engage in air transportation between the United States and foreign countries. The Board has jurisdiction over tariffs and the rates and fares charged the public for air transportation. The CAB sets the rates for the carriage of mail by air carriers. In the interest of maintaining competition, the CAB passes upon mergers, agreements, acquisitions of control, and interlocking relationships involving air carriers.

2. Extent of Present Metric Usage. Metric usage in the CAB is virtually non-existent. The sole known exception concerns minimal conversion of statistical data for international information exchanges. There are no detectable trends of metric usage within the CAB or within the industry regulated by the CAB.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). The CAB foresees no increased metric usage under this assumption, even though there will be increasing problems of international cooperation.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Conversion to metric from customary usage would mean that distance and weight measures in historical information inventories and tariff or other economic regulations would have to be converted. Historical information inventories could be converted as drawn upon for use. Conversion of regulations could largely be accomplished on an evolving basis. No cost impacts upon CAB are anticipated under this assumption.

The principal long-term advantage to CAB would be improved international communication. The advantages of the changeover would outweigh the disadvantages. Coordinated, compatible conversion with the regulated air carrier industry would be the only significant obstacle. However, simplified coordinated operations on a world-wide basis would result.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). Since engineering standards are not significant to CAB activities, metrication in this area would have virtually no additional impact on the agency.

6. Conclusion. The advantages or disadvantages of metrication are not sufficiently great for CAB to express a preference concerning the advisability of planned national effort in this respect. From the point of view of the Board alone the project would not be undertaken except as a coordinated part of a larger industrial or national effort.

Impact of Metrication on Air Transportation

Present Metric Usage. The metric system is used in less than one-quarter of all work situations within the industry regulated by CAB. No trends toward metric usage are detected. The impact on the air transportation industry has been *negligible.*[1] Conversions for international statistical exchanges and international transportation pricing analyses would be the only substantive impact of metrication on the air transportation industry regulated by CAB.

Future Impacts of Metrication. Increasing worldwide and domestic metric usage will have a *negligible* impact on the Board's air transportation responsibilities assuming no concerted national action to increase metric usage. Under this assumption, there would also be *negligible* impact on the ability of CAB to perform its mission.

If there were a nationally planned program, a conversion period of 10 years would be adequate to effect a conversion with *negligible* effect on the Board and the air carriers. Adoption of metric units would improve CAB's effectiveness only slightly.

What Action Should Be Taken? Worldwide standardization of measurement units would obviously be advantageous. However, the benefits and burdens on the CAB and the air transportation industry themselves would not be sufficient to form a basis for the Board to endorse or reject such a national program.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

FEDERAL COMMUNICATIONS COMMISSION (FCC)

Liaison Representative:

Julian T. Dixon, Assistant Chief Engineer

Respondent—Internal Operations:

1. Technical Division, Office of Chief Engineer

Respondent—Telecommunications Area of National Responsibility:

1. Technical Division, Office of Chief Engineer

1. Mission of the Federal Communications Commission. The FCC was created for the purpose of regulating interstate and foreign commerce in communication by wire and radio so as to make available, so far as possible, to all the people of the United States a rapid, efficient, nationwide and worldwide wire and radio communication service with adequate facilities at reasonable charges, for national defense, to promote safety of life and property, and to insure effective execution of this policy by centralizing authority in one agency.

2. Present Metric Usage. Because the industry with which the FCC deals normally uses the metric system, almost 100 percent of the technical data and radio regulations with which FCC deals are in the metric system. The only exceptions are those customary units or standards which the communications industry normally uses, such as distance in miles or antennae height in feet.

The FCC sees no disadvantages in its present use of the metric system. The benefits of better international cooperation through metric usage are incidental in most cases.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Since the metric system is used in virtually all of FCC's technical and engineering work, there will be no further changes to metric under this assumption.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). For the reason stated with respect to the above assumption, impacts under Assumption II would be insignificant. The impacts on the non-technical areas of FCC, which now operate on the customary system, would also be insignificant.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). The impacts under this assumption would be identical to those under the prior assumption.

6. Conclusion. FCC would like to see concerted national action in the United States to bring about a gradual changeover toward metrication in both units and engineering standards.

Impact of Metrication on Telecommunications

Present Metric Usage. The metric system is used in virtually all aspects of the communications industry over which the FCC has cognizance. There is no trend toward converting the few exceptional customary units or standards (e.g., antennae heights in feet) to metric measures. The impact of increasing metric usage has had *negligible*[1] effect on telecommunications.

Future Impacts of Metrication. If there is no concerted national action to increase the use of the metric system, there will be no effect on the telecommunications area over which FCC has responsibility. There would also be no impact on the ability of FCC to perform its mission with respect to the communications industry; thus, the impact on FCC's effectiveness would be *negligible*.

Under a nationally planned program to increase the use of the metric system, there would also be *negligible* impact. Since the FCC, and the communications industry with which it deals, are basically operating on the metric system already, adoption of the metric system in the United States would have no effect on FCC's effectiveness.

What Action Should Be Taken? The FCC believes that there should be a gradual changeover to the metric system in the United States.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

FEDERAL MARITIME COMMISSION (FMC)

Liaison Representative:

Edward F. Hawkins, Assistant Chief for Tariffs, Office of Tariffs and Practices, Bureau of Compliance

Respondents — Internal Operations:

1. Bureau of Compliance
2. Bureau of Domestic Regulation
3. Bureau of Financial Analysis
4. Bureau of Investigation

Respondents — Transportation Area of National Responsibility:

1. Chairman, Federal Maritime Commission
2. Office of Tariffs and Informal Complaints, Bureau of Compliance

1. Mission of the Federal Maritime Commission. The FMC administers the broad regulatory provisions of the various shipping acts, covering common carriers by water engaged in both foreign commerce and in domestic offshore trade. These regulatory provisions are concerned with rates, fares, charges, classifications, tariffs and practices of common carriers by water. The Commission also accepts, rejects, or approves tariff filings of common carriers engaged in foreign commerce. Freight rates and other charges published by ocean carriers are the activities most likely to be affected by metrication.

2. Extent of Present Metric Usage. Metric measurement units (meters and kilograms) are used in approximately 20 percent of the freight tariffs on file with the Bureau of Compliance. Two disadvantages of present usage are cited: lack of familiarity with metric units on the part of the employees, and confusion because of the dual system. FMC is not involved at all with metric-based engineering standards.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Under this assumption, FMC does not anticipate increasing metric usage within its operations. The respondents foresee no problems if the agency makes no future changes toward metric usage, even though there will be greater metric usage on an evolutionary basis in the United States and in foreign countries.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). Under this assumption, none of the four respondents anticipate internal savings or added costs during either the transition period or the post-transition period.

Both the Bureau of Compliance and Bureau of Investigation cite operational improvement as an advantage of metrication because of uniformity. A changeover would simplify the tariff filings since about 20 percent of all tariff filings are now in metric units. The Bureau of Financial Analysis sees a disadvantage of metrication in the lack of comparability of data for previous years.

The Bureau of Compliance and Bureau of Investigation believe that advantages of metrication would outweigh disadvantages. The Bureau of Financial Analysis does not believe that advantages would outweigh disadvantages because of incompatibility of data from carrier to carrier and from year to year. The Bureau of Domestic Regulation is uncertain whether advantages would outweigh disadvantages.

In order to implement the changeover under Assumption II, the Bureau of Compliance would have to publish tariff filing rules in metric units. The Bureau of Financial Analysis would have to prescribe new definitions. No other needed changes are foreseen.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). Since the FMC does not use engineering standards, no impacts upon FMC are anticipated in addition to those described under the prior assumption.

6. Conclusion. The Bureau of Compliance and the Bureau of Investigation favor concerted action in the United States to bring about changes toward increased use of metric measurement units. The Bureau of Compliance believes that the general public should be made aware of the advantages of the metric system. The Bureau of Investigation believes that concerted action and extensive educational programs are the only ways to bring about metrication effectively. The Bureau of Investigation thinks that a 10-year transition period would be satisfactory; the Bureau of Compliance is not sure.

The Bureau of Financial Analysis is not in favor of a concerted national program to increase the use of metric measurement units. The Bureau of Domestic Regulation is uncertain whether it favors a metrication program. The Chairman of FMC does not express an opinion on whether there should be coordinated action in the U.S. to bring about changes toward metrication.

Since FMC is not involved with engineering standards, it is uncertain whether it favors a concerted national program to increase the use of metric-based engineering standards.

Impacts of Metrication on FMC's Transportation Area of Responsibility

Present Metric Usage. About 20 percent of the tariffs filed with the Commission use metric units. There appears to be no noticeable trend toward increased metric usage in the Commission's area of responsibility. In the Commission's opinion, the impact of the increasing metric usage on its transportation responsibilities has been *negligible*.[1]

Future Impacts of Metrication. The Commission believes that increasing metric usage without a nationally coordinated program will have no impact on transportation. No difficulties are foreseen for the Commission's performance of its mission, either.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

If there were a nationally coordinated program to increase metric usage, there would be *negligible* impact upon the Commission's transportation area of responsibility. The Commission foresees no problems concerning its ability to carry out its mission if there were a concerted program. A changeover, in fact, would simplify tariff filings since the present dual system would be eliminated. The impact of concerted national action on the Commission's ability to perform its mission would be *negligible*.

What Action Should Be Taken? The Commission recommends a promotional program to bring to the attention of the general public the advantages of the metric system. .

FEDERAL POWER COMMISSION (FPC)

Liaison Representative:

Stewart P. Crum, Chief, Division of Electric Resources and Requirements, Bureau of Power

Respondents — Internal Operations:

1. Bureau of Power
2. Bureau of Natural Gas
3. Office of Accounting and Finance

Respondents — Energy (Natural Gas and Electric Power Industries) Area of National Responsibility:

1. Bureau of Power
2. Bureau of Natural Gas
3. Office of Accounting and Finance

Respondents — Environmental Pollution Control Area of National Responsibility:

1. Bureau of Power
2. Bureau of Natural Gas
3. Office of Accounting and Finance

1. Mission of the Federal Power Commission. The Federal Power Commission regulates the interstate aspects of the electric power and natural gas industries, including the issuance of licenses for the construction and operation of non-Federal hydroelectric power projects on Government lands or on navigable waters of the United States, the regulation of rate and other aspects of interstate wholesale transactions in electric power and natural gas, and the issuance of certificates for gas sales to and from interstate pipelines and for the construction and operation of pipeline facilities.

2. Present Metric Usage. The Federal Power Commission does not generally use metric measurement units or metric engineering standards in its operations, except for the basic units of electricity — watt, ampere, volt, ohm — which are an inherent part of both the U.S. customary system and the international metric system.

3. Anticipated Changes If There is No National Plan for Metrication (Assumption I). Under this assumption, FPC anticipates no increase in metric usage. There will be problems of international cooperation and increased conversion, however, if no changes toward increased metric usage are made.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). If there were a planned national effort to adopt metric units of measurement, the forms and schedules which the Commission issues for the purpose of collecting electric power and natural gas data would have to be revised to reflect the new measurement system. FPC rate schedules, especially those filed with the Bureau of Natural Gas, would require a prompt and comprehensive changeover to the metric equivalence. It is estimated, however, that the cost of revising about 16,000 rate schedules and tariffs on file, in accordance with the Commission's rulemaking procedures, would be minimal (an annual cost of about $15,000 during the transition period). The metric changeover of most other reports could be accomplished when these reports are routinely revised, both on the recommendations of the Commission's staff and of industry. Approval by the Office of Budget and Management is generally required for changes in reporting procedures to minimize the burdens of furnishing information to Federal agencies. No cost impacts would be anticipated during the post-transition period.

At present, the FPC furnishes a small amount of power system data, converted into metric units, for publication by two international organizations: the Economic Commission for Europe (ECE) and the Organization for Economic Cooperation and Development (OECD). It is not known whether U.S. adoption of the metric measurement system would promote further cooperation with foreign counterparts. It should be noted, however, that the units of measurement are not the only "language" barrier between the U.S. and foreign countries. The ECE and OECD questionnaires have caused some confusion in this country concerning the basic definition of "generating plant capacity".

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). The impacts upon the FPC under this assumption would be nearly identical to those under the prior assumption. Since the FPC is primarily a regulatory agency rather than an operating or design agency, the adoption of metric engineering standards necessarily would have less impact upon the Commission's internal operations than upon the industries it regulates. However, at least one function of the Commission would be affected by adoption of a new set of engineering standards. This function is the FPC's responsibility in studying the safety and adequacy of licensed hydroelectric projects. Safety codes covering electrical, structural, and hydroelectric design criteria are oriented toward non-metric engineering standards. The difficulty of performing engineering analyses under two sets of standards (assuming not all companies would submit plans and drawings conforming to the new standards during the transition period) would be essentially one of familiarizing the staff with the metric engineering methods. There would be only minimal cost to FPC in participating in conversion of engineering standards and the Commission's Rules and Regulations.

6. Conclusion. The FPC relies heavily on cooperation through its industry advisory groups for projecting possible patterns in the development of electrical energy systems. It is suggested that proposals for changing to metric standards be similarly coordinated with industry advisory groups. A "U.S. Metric Study Advisory Committee" should represent the manufacturing and consulting segments of the industries as well as the individual utilities.

Impacts of Metrication on the Natural Gas and Electric Power Industries

Present Metric Usage. The metric system is used for less than one-fourth of all work activities within the power industry in the United States. Present metric usage is confined mostly to the basic units of electricity—the watt, ampere, volt, ohm. The U.S. electric power and natural gas industries have generally adhered to non-metric units of measurement and engineering standards. Foreign equipment purchased by U.S. utilities is normally accompanied by drawings and specifications which have been converted to the U.S. customary dimensions and values. The U.S. electric power industry has shown no inclination to increase usage of the metric system.

There is, however, a discernible trend in metric usage by the natural gas industry. Pipe, a major component of gas systems, is frequently purchased under American Petroleum Institute specifications. Since the early 1960's these specifications have contained metric as well as English dimensions so that pipe can be ordered and manufactured using either system. Thus far, increasing metric usage has had *negligible*[1] impact within the power industry in the United States.

Future Impacts of Metrication. The FPC believes that the U.S. electric power and natural gas industries apparently will not, of their own accord, change from the conventional measurement system in use. Nor in the near future are the industries likely to support legislation to require a change. The cost of changeover, the impracticability of maintaining equipment designed under two sets of standards, and the unfamiliarity of U.S. engineers with metric standards appears to offset the advantages (increased international cooperation and the convenience of a numbering system which does not require the use of fractions).

There will be *negligible* impact upon the ability of the FPC to perform its mission with respect to the power industry if there is merely an evolutionary increase in metric usage. Except in the case of a relatively small number of studies, the FPC does not require the filing of detailed engineering plans and design calculations of electric power and natural gas facilities. Thus, even with increased purchases of foreign equipment, it is expected that the impact on the FPC at the present level of metric usage would be *negligible*.

If there were a concerted national plan to increase metric usage, the new measurement units would place a particular burden on the areas of equipment specification, design, construction and maintenance. The FPC has relatively little involvement with the manufacturing segment of the power and gas industries, but it can be assumed that the manufacturers have already supplied equipment, presumably built with metric specifications, to foreign utilities. The problems of adapting to metric engineering standards would exist at the interfaces between manufacturers, engineering consultants, and utilities. The general absence, in the U.S. of texts, handbooks, codes and other familiar references incorporating metric engineering standards, together with the obvious necessity for maintaining two sets of specifications, parts and tools during the lifetime of older equipment, would further complicate the process of metrication. The gas industry, however, has already taken steps toward incorporating metric engineering standards (e.g., pipe specifications described above).

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[1] See "Classification of Intensities of Impact" scale on p. 79.

The lifetime and scheduled retirements of industry equipment are a principal factor in determining a suitable non-metric to metric transition period. This factor is further complicated by the rapid growth of the industry. Apparently, not all segments of the industry would be able to meet the same time schedule for a nationally planned program to adopt the metric system.

The FPC does not know if adoption of the metric system would improve or impair its effectiveness in dealing with the power industry. Large electric and gas utilities probably would comply readily in meeting the FPC reporting requirements following a changeover to the metric system. Smaller utilities and municipal power companies may not have the staff to convert drawings, maps, and other reported data to the new system. It is possible, however, that schedules for reporting system data would incorporate two columns (for the old and new units) in addition to two measurement scales for maps, to minimize confusion during the transition period. FPC operations requiring new sets of safety and design standards might be hindered until such standards are available.

What Action Should Be Taken? Industry advisory groups should be consulted on the problems involved in conversion to metric system standards. Research efforts in power and gas related technologies should be encouraged to utilize metric engineering practices, if not already implemented in the laboratory. This may help insure that future generations of engineering texts, standards, and handbooks are authored by scientists and engineers who are familiar with the advantages of metrication in industry.

Many questions remain to be answered. What effect would metrication have on the lead times of new installations? What portion of the increased costs resulting from metrication would be passed on to the consumer? What support would be required for engineering colleges to reorient their programs and texts to the metric nomenclature? The Commission is prepared to act upon government and industry guidelines which might be proposed for development of a uniform program of metrication.

Impacts of Metrication on Environmental Pollution Control

The primary focus within the power industry has been on electrostatic precipitators and cooling towers to protect the environment against waste heat and atmospheric pollution. These devices have come to be regarded as appurtenant facilities in generating plant design and, as such, should be coordinated in the metrication scheme with conventional equipment. Thus far, the impact of metrication upon the pollution control field has been *negligible* and would continue to be so unless there is concerted action to increase use of metric engineering standards.

FEDERAL TRADE COMMISSION (FTC)

Liaison Representative:

Joseph Dufresne, Chief, Division of Special Projects

Respondent — Internal Operations:

1. Division of Special Projects

Respondent — Trade Practices Area of National Responsibility:

1. Division of Special Projects

1. Mission of the Federal Trade Commission. In brief, the Commission is charged with keeping competition both free and fair. The Federal Trade Commission Act lays down a general prohibition against the use in commerce of "unfair methods of competition" and "unfair or deceptive acts or practices." The Clayton Act outlaws specific practices recognized as instruments of monopoly. As an administrative agency, acting quasi-judicially and quasi-legislatively, the Commission was established to deal with trade practices on a continuing and corrective basis. It has no authority to punish; its function is to "prevent," through cease-and-desist orders and other means, those practices condemned by the law of Federal trade regulation.

The Commission's principal functions are as follows:

To promote free and fair competition in interstate commerce through prevention of price-fixing agreements, boycotts, combinations in restraint of trade, and other unfair methods of competition.

To safeguard the consuming public by preventing the dissemination of false or deceptive advertisements of food, drugs, cosmetics, and therapeutic devices, and other unfair or deceptive practices.

To prevent discrimination in price, exclusive-dealing and tying arrangements, and corporate mergers when such practices or arrangements may substantially lessen competition or tend toward monopoly; interlocking directorates under certain circumstances; the payment or receipt of illegal brokerage; and discrimination among competing customers in the furnishing of or payment for advertising or promotional services or facilities.

To enforce truthful labeling of textile and fur products.

To prevent the interstate marketing of dangerously flammable articles of wearing apparel and interior furnishings and of dangerously flammable fabrics and related materials intended for use or which may reasonably be expected to be used in any such product.

To regulate packaging and labeling of certain consumer commodities so as to prevent consumer deception and facilitate value comparisons.

To supervise the registration and operation of associations of American exporters engaged solely in export trade.

To petition for the cancellation of the registration of trademarks which were illegally registered or used for purposes contrary to the intent of the Trade-Mark Act of 1946.

To achieve true credit cost disclosure by consumer creditors (retailers, finance companies, non-Federal credit unions, and other creditors not specifically regulated by another Government agency); and to assure a meaningful basis for informed credit decisions.

To gather and make available to the Congress, the President, and the public, factual data concerning economic and business conditions.

2. Effect of Metrication on the Internal Operations of the Federal Trade Commission. The basic Act administered by the Commission is the Federal Trade Commission Act. Also administered are all or parts of other Acts such as the Robinson-Patman amendment to the Clayton Act, certain other sections of the Clayton Act, the Textile Fiber Products Identification Act, Fair Packaging and Labeling Act, Truth in Lending Act, Public Health Cigarette Smoking Act, and others.

Essentially, these statutes involve the regulation of trade practices within the United States, and one aspect of such regulation is the prescribed labeling of products. The disciplines involved in implementing the various statutes are essentially law and economics. The various purely scientific disciplines involved are extremely rare in application, and hence the effects of metrication on the Commission's operations will not be primary in nature. There could be some secondary effects, but the secondary effects will probably be no greater than those which affect the public at large.

With particular reference to the Fair Packaging and Labeling Act, the manner of expressing the quantity of contents on the labeling of consumer commodities is prescribed. The Act specifies that the declaration of contents must be in terms of the avoirdupois or fluid ounce, or the inch, foot, or yard, or in the instance of larger quantities in pints, quarts, gallons, or pounds (Section 4). The Commission's regulations implementing the Act require the customary units. Assuming a conversion to the metric system, obviously a change in format prescribed by the regulations would require administrative action (assuming that there would be legislation requiring use of metric in the Act). While such a change would involve some administrative effort by the Commission, the impact would be felt primarily and to a substantial degree by the packagers and labelers subject to the Act, and in turn by the consumer.

In the implementation of the Public Health Cigarette Smoking Act, the Commission operates a laboratory to determine the tar and nicotine content of cigarettes. As one would anticipate, the custom of a laboratory to express finite quantities of milligrams is followed. Essentially, increased metrication would not affect this function of the Commission. Nor does it appear that increased metrication would in any manner affect the routine of the Commission's Division of Scientific Opinions which operates to assist legal staff primarily in actions implementing the various statutes administered. To the degree the staff of the Division of Scientific Opinions is trained in disciplines such as those represented by physical and natural sciences, the staff "thinks" in terms of the metric system. However, this Division does not include operating laboratories beyond that required to determine tar and nicotine in cigarettes.

The Bureau of Textiles and Furs maintains a laboratory for the analysis of textiles and furs, but again the metric system is involved only to the extent that normal chemical apparatus will be calibrated in the metric system and the techniques presuppose use of the metric measures.

In summation, the Commission will not be significantly affected by increased metrication, but will be affected to the same degree that the public in general will be affected. This effect inevitably will involve an educational process rather than a changeover in specifics such as the formulation of new specifications, or the calibration of machines and instruments.

3. Impact of Metrication on Trade Practices, Area of National Responsibility of the Federal Trade Commission (FTC). The FTC is primarily concerned with the trade practices engaged in by industries functioning in, or whose products are distributed in, the United States. Unlike transportation or communication-oriented agencies, the FTC adjudicates rather than legislates, and accepts trade practices whatever they may be, provided they are compatible with good business practices and devoid of deception. FTC promulgates Trade Regulation Rules, and administers some statutes, such as the Fair Packaging and Labeling Act. In prescribing aspects of product labeling, the statutes accept customary standards, including weights and measures. Thus, the Agency can and will prescribe how ounces, pints, pounds, inches, feet, and yards will be stated on labeling, but it cannot, nor does it attempt to prescribe other forms of measurement. In almost no phase of the FTC's efforts is the metric system a necessary factor.

The Federal Trade Commission estimates that the metric system is currently used in less than one-fourth of the Nation's trade practices. No trends in metric usage are evident in this area and the FTC estimates that increasing worldwide and domestic use of the metric system has had a *negligible*[1] impact on the Nation's trade practices.

Assuming that there is no concerted national action with regard to metrication, the FTC estimates that the Nation's trade practices will remain unaffected by increasing domestic and international use of the metric system. Imported products originating in "metric" countries will continue to bear required American expressions of weights and measures, as in fact most must do at this time. But even this necessity is limited within the framework of "consumer commodities" as defined in, and regulated by, the Fair Packaging and Labeling Act.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

If there were a nationally planned program to increase use of the metric system over a 10-year period, the effect on industries subject to regulation of trade practices is estimated by the FTC to be initially a change of product labeling to show measurements in the metric system. All labels and packages would require revision and, in turn, printing plates would have to be revised or remade. The package industry might have to re-tool (e.g., bottles now designed for quarts might have to be replaced with bottles designed for liters). In addition, the public would have to be more familiar with metric measures. Since labels are continually being revised, industry could possibly use existing containers, i.e., label the quart as .946 liter, and not attempt widespread use of unit liters or unit quarts.

The FTC estimates that increasing domestic and international use of the metric system has had a *negligible* impact on its ability to perform its mission with respect to the Nation's trade practices. The FTC is unable to estimate whether or not adoption of the metric system would improve its effectiveness in this area.

4. Conclusion. Because of the unique nature of the FTC's area of national responsibility and the fact that its internal operations are unlikely to be greatly affected by increased metrication, any "standpoint" the FTC might take on metrication would be basically academic rather than practical. The reaction of the FTC's staff to this issue is, therefore, "no position."

GENERAL SERVICES ADMINISTRATION (GSA)

Liaison Representative:

L. F. Donahue, Staff Director for Standards Activities, Federal Supply Service

Respondents — Internal Operations:

1. Office of Administration
2. Office of General Counsel
3. National Archives and Records Service
4. Property Management and Disposal Service
5. Office of Design and Construction
6. Transportation and Communication Service
7. Federal Supply Service
8. Office of Supply Distribution
9. Office of Supply Control
10. Office of Automated Data Management Services
11. Office of Procurement
12. Quality Control Division
13. Standardization Division
14. Material Evaluation and Development Laboratory
15. Magnetic Surfaces Laboratory

Respondent — Consumer Affairs Area of National Responsibility:

1. Federal Supply Service

1. Mission of the General Services Administration. The GSA is responsible for the development of policy, issuance of regulations, and the conduct of operations, to the extent appropriate, with respect to Government programs for the management of real property, personal property, and records, and assistance to Federal agencies in transportation and public utilities management. The effects of metrication will be felt primarily in those areas having to do with specifications for buildings, equipment and materials, the maintenance of inventories and the operation of laboratories and other facilities involving the use of instruments and equipment.

2. Extent of Present Metric Usage. Only six out of 15 respondents now use the metric system. These are Federal Supply Service, Office of Automated Data Management Services, Office of Supply Control, Quality Control Division, Standardization Division, and Material Evaluation and Development Laboratory. The present use of metric measurement units is confined to a small number of specifications (some stock items and EDP equipment) and to equipment and procedures in laboratories, especially in the optical, electrical, and chemical areas. The use of metric engineering standards and measurement units is confined to the same areas but is minimal. The use of metric measurement units and engineering standards has been adopted in those few cases where metric use in the industries or operations with which GSA deals has become common. The trend to the present has been to adopt metric units only where such usage has become common among the outside organizations with which GSA deals.

The Federal Supply Service and the Material Evaluation and Development Laboratory cite costs savings and operational improvements as advantages of present usage. There have been few or no disadvantages from the present metric usage.

GSA has no programs which would generate an internal need for a change to metric measurement units or engineering standards. Almost all GSA operations are intimately involved with other Government agencies and with the industrial and commercial world. Commonality of language with these groups is essential to efficient communication and operations. GSA would wish only to make changes in concert with the organizations with which it deals. While there are some problems and costs in such changes, no serious obstacles are foreseen.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Under this assumption, GSA anticipates changes in metric units and engineering standards only to the extent that commercial and industrial entities make such changes. The Federal Supply Service and the Standardization Division expect that changes in GSA will be made for the purpose of maintaining a common language and to conform to commercial and industrial usage and practices. Under this assumption it is anticipated that such changes will be progressive and in all likelihood could be synchronized with other changes in specifications and material usage. In such cases the cost will probably be negligible. The Federal Supply Service expects short-term cost increases of less than 1 percent due to computation and incorporation of dual measurements and a limited increase in number of items stocked. The Standardization Division expects temporary cost increases of 1 to 5 percent because of recomputations of dimensions and tolerances. These changes will have little or no effect on mission capability and will have the advantage of avoiding problems caused by dual language and inconsistent practices between GSA and the industrial world.

If there are no changes toward increased use of metric measurement units or engineering standards by GSA in the absence of a planned national action, GSA expects problems of increasing intensity, including problems of increased inventory, international cooperation, increased conversion, and increased interfacing.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption, GSA would encounter added costs during the transition period of somewhat more than $1 million per year. Seven responding subdivisions expect cost increases during the transition period, six expect no cost impacts, and two are uncertain whether there would be any cost impact.

The following expect cost increases during the transition period:

a. Property Management and Disposal Service—an annual increase of $700,000 per year (1-5 percent)—$200,000 for inventory, $100,000 for accounting, $100,000 for inspection, $100,000 for purchasing, and $200,000 for storage activities.

b. Federal Supply Service – an annual increase of $365,000 (less than 1 percent) – $220,000 for specifications, $100,000 for cataloging, $25,000 for laboratories, and $20,000 for training activities.
c. Office of Automated Data Management Services – an increase of 5 to 10 percent.
d. Office of Supply Distribution – an annual increase of $40,000 (1-5 percent) or $20,000 for specifications and order changes and $20,000 for employee training.
e. Office of Supply Control – an annual increase of $100,000 (less than 1 percent for cataloging costs).
f. Standardization Division – an annual increase of $200,000 (less than 10 percent) for specifications activities.
g. Material Evaluation and Development Laboratory – an annual increase of $25,000 (1-5 percent) for mechanical activities.

During the transition period, the following expect no cost impact: Office of the General Counsel, National Archives and Records Service, Office of Procurement, Quality Control Division, Magnetic Surfaces Laboratory and the Transportation and Communication Service. The Office of Administration and Office of Design and Construction are uncertain whether there would be any cost impact.

During the post-transition period neither net savings nor net additional costs are anticipated for GSA as a whole. Two respondents expect savings, one expects increased costs, 10 expect no cost impacts, and two are uncertain.

Two groups expect cost savings during the post-transition period.

a. Property Management and Disposal Service – a savings of 1 to 5 percent.
b. Office of Automated Data Management Services – a savings of 5 to 10 percent.

The Material Evaluation and Development Laboratory expects a cost increase of 1 to 5 percent or $10,000 annually during the post-transition period.

The following anticipate no cost impacts during the post-transition period: Office of the General Counsel, National Archives and Records Service, Federal Supply Service, Office of Procurement, Office of Supply Control, Quality Control Division, Standardization Division, Magnetic Surfaces Laboratory and the Transportation and Communication Service. The Office of Administration and Office of Design and Construction are uncertain as to the extent of the cost impact.

Following the transition period, eight groups foresee long-term advantages. The advantage most often cited is improved international communication due to a common system of measurement. The Property Management and Disposal Service and Federal Supply Service foresee cost decreases in the long term; these two groups along with the Quality Control Division expect operational improvement. The Property Management and Disposal Service, Federal Supply Service, and Magnetic Surfaces Laboratory believe that in the long term, U.S. standards can be better promoted internationally if they are in metric units.

On the other hand, the Office of Design and Construction and the Material Evaluation and Development Laboratory expect cost increases and operational impairment over the long term if there is metrication in units only; these disadvantages, however, would not occur if there were a conversion to metric engineering standards.

In general, the advantages of a planned program of metrication in measurement units would outweigh the disadvantages. Six groups believe that the advantages would predominate: these are: Office of Administration, Federal Supply Service, Office of Automated Data Management Services, Office of Supply Distribution, Quality Control Division, and Material Evaluation and Development Laboratory. Four believe that the advantages would not outweigh disadvantages; these are: National Archives and Records Service, Property Management and Disposal Service, Office of Design and Construction, and Magnetic Surfaces Laboratory.

The changeover would probably be implemented by the progressive revision of specifications and of other documents and operating procedures, geared to the commodity area and the sequence of change occurring in the industrial world. Measurement units would have to be converted on drawings, specifications, and criteria. Architects and engineers would have to use metric measurement units for drawings and specifications. GSA would have to re-train some of its personnel and would also have to provide conversion tables. No significant legal or other problems are foreseen.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Measurement Units (Assumption III). Under Assumption III, GSA anticipates an added cost per year of more than $2 million, substantially more than the $1 million cited under the prior assumption. Three of the respondents report *different* cost impacts under this assumption than are given under the prior assumption (one expects different cost impacts during the transition and three expect different cost impacts during the post-transition).

Eight of the 15 respondents expect that the impacts, including costs, under this assumption would be identical to those described under the prior assumption; these are Office of the General Counsel, National Archives and Records Service, Property Management and Disposal Service, Office of Automated Data Management Services, Office of Procurement, Office of Supply Distribution, Magnetic Surfaces Laboratory, and Transportation and Communication Service.

During the transition period, the Federal Supply Service (the only respondent expecting a cost impact under this assumption different from that under the prior assumption) expects a cost increase of less than 1 percent or $1,275,000 per year. The cost increase is broken down as follows: $420,000 for specifications, $100,000 for cataloging, $710,000 for inventories, $25,000 for laboratories, and $20,000 for training activities.

There would be a net annual added cost to GSA of over $100,000 for an indefinite period after the transition under Assumption III. During the post-transition period, the responses are identical to those described under the prior assumption with the exceptions described below. Two expect increased costs under Assumption III even though they do not expect increased costs during the post-transition under the prior assumption. These are as follows:

a. Federal Supply Service—an annual cost increase of about $100,000 for dual inventories of replacement parts and equipment.
b. Office of Supply Control—an annual cost increase of about $100,000 (less than 1 percent) for dual inventories of replacement parts and equipment.

The Material Evaluation and Development Laboratory expects a *savings* of 1 to 5 percent or $10,000 annually. Under Assumption II, that group expects a cost *increase* of $10,000 annually.

The long term advantages and disadvantages under Assumption III are identical to those described under Assumption II in the opinions of all but two respondents. Both the Office of Design and Construction and the Material Evaluation and Development Laboratory expect long-range cost decreases and operational improvement under Assumption III; under the prior assumption, both expect cost increases and operational impairment. The Office of Design and Construction also anticipates better promotion of U.S. standards internationally and improved international communication under Assumption III.

In general, the advantages of a planned program of metrication in engineering standards as well as in measurement units would outweigh the disadvantages (as was the case under the prior assumption). The Office of Automated Data Management Services does not believe that the advantages would outweigh the disadvantages under Assumption III, even though the advantages would predominate under Assumption II. On the other hand, the Office of Design and Construction believes that the advantages of metrication under Assumption III would outweigh the disadvantages; under the prior assumption, the advantages would not predominate.

The Office of Design and Construction explains in detail the disadvantages of converting to metric units without converting to metric engineering standards. The disadvantages are: increased use of fractional dimensioning; increased "cutting and fitting" in the field, resulting in increased construction time and cost; inhibiting of advances in the area of prefabrication and systems building; and the necessity of conversion of non-metric engineering standard measurements to metric equivalents for design and dimensioning purposes.

The advantages of converting to metric engineering standards, as well as to metric measurement units, would outweigh the disadvantages because dimensioning would be simplified and American products would eventually be in a better position to compete with foreign products in the export market. Also, conversion of engineering standards would enable the U.S. construction industry to make more use of foreign developed engineering standards and foreign products. Even though restrictions imposed by the "Buy American" act would still apply to Public Building Service projects, and there would undoubtedly be conversion problems on the part of American industry during the transition period, the results at the end of the 10-year conversion period should be reduced costs due to increased competition from abroad.

GSA would implement the changeover in step with changes in the various industries with which it deals. Implementation procedures under Assumption III are very similar to those described under Assumption II. The Standardization Division would have to reissue all specifications and standards in addition to the procedures identified under the previous assumption. The Office of Design and Construction would have to gradually phase in metric engineering standards in place of non-metric. Non-metric replacement parts would have to be obtained for existing equipment and facilities. The Material Evaluation and Development Laboratory would have to convert Federal specifications and standards; this would cause an additional work load on laboratory personnel. The laboratory would also have to make physical changes on machine tools.

6. Conclusion. Seven of the 15 respondents favor a nationally coordinated program to increase the use of metric measurement units; these are: Office of Administration, Property Management and Disposal Service, Office of Automated Data Management Services, Office of Supply Distribution, Office of Supply Control, Quality Control Division, and Material Evaluation and Development Laboratory. Only the Office of Design and Construction does not favor such a program. The remainder do not know or do not provide answers.

Seven of the 15 respondents favor a nationally coordinated program to increase the use of metric engineering standards as well as metric measurement units. Two respondents provide different responses with regard to metrication in both units and standards than they do with regard to metric units only. The Office of Design and Construction favors a national program with regard to both standards and units; it does not favor a program for units only. The Office of Supply Control is uncertain with regard to both units and standards, even though it does favor metrication in units only.

The following types of concerted action are suggested: public education, legislation making use of the metric system mandatory, and executive orders making use of the metric system feasible in the Federal Government. The Office of Design and Construction suggests that encouragement be given to industry and the standards-developing bodies such as American Society for Testing and Materials and American National Standards Institute to develop standards over the 10-year transition period. The proposed 10-year period for transition seems to be satisfactory for GSA, especially in view of the fact that most manufacturers make substantial changes to standard products in less than 10-year intervals.

While GSA has no internally generated need for change toward metric measurement units or engineering standards, it is considered important that whatever changes take place, whether in industry or Government, be carefully coordinated.

Impacts of Metrication on Consumer Affairs

Present Metric Usage. In the field of consumer affairs, GSA has no formally assigned responsibility, but is itself a buyer of a large number of items, similar to, if not identical with, those purchased by individuals for their own use. From this vantage point, little use of the metric system is apparent and there is no appreciable trend. As far as can be seen, the impact has been *negligible.*[1]

Future Impacts of Metrication. Since GSA has no established responsibility in the area of "consumer affairs" any impact on its own effectiveness is unlikely.

A nationally planned program to increase the use of the metric system would forestall the confusion to consumers which an unplanned increase would create, but would introduce the practical difficulty of educating the public in the use of metric units. A 10-year period for this program would appear to be reasonable. There would be no effect on the Agency's ability to perform its mission.

What Action Should Be Taken? GSA has no firm opinion as to the action the U.S. should take with respect to the increase in use of the metric system, insofar as individual consumers are concerned.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

INTERSTATE COMMERCE COMMISSION (ICC)

Liaison Representative:

Martin E. Foley, Acting Managing Director

Respondent — Internal Operations:

1. Acting Managing Director

Respondent — Transportation Area of National Responsibility:

1. Acting Managing Director

1. Mission of the Interstate Commerce Commission. The Commission was created by Congress to regulate, in the public interest, carriers subject to the Interstate Commerce Act which are engaged in transportation, in interstate commerce, and in foreign commerce to the extent that it takes place within the United States. Surface transportation under the Commission's jurisdiction includes railroads, trucking companies, bus lines, freight forwarders, water carriers, oil pipelines, transportation brokers, and express agencies.

In broad terms within prescribed legal limits, Commission regulation encompasses transportation economics and service.

In the transportation economics area, the Commission settles controversies over rates and charges among competing and like modes of transportation, shippers and receivers of freight, passengers, and others. ICC rules upon applications for mergers, consolidations, acquisitions of control, and the sale of carriers and issuance of their securities. It prescribes accounting rules, awards reparations, and administers laws relating to railroad bankruptcy. It acts to prevent unlawful discrimination, destructive competition, and rebating. ICC also has jurisdiction over the use, control, supply, movement, distribution, exchange, interchange, and return of railroad equipment where needed. Under certain conditions, it is authorized to direct the handling and movement of traffic over a railroad and its distribution over other lines of railroads.

In the transportation service area, the Commission grants the right to operate to trucking companies, bus lines, freight forwarders, water carriers, and transportation brokers. It approves applications to construct and abandon lines of railroad, and it rules upon discontinuances of passenger train service.

2. Effect of Metrication on the Internal Operations of the ICC. The Interstate Commerce Commission is not involved to any degree in the use of metric units or metric engineering standards (the ICC is seldom involved in activities where engineering standards would be significant) and sees no identifiable trends in that direction. The statistical data and information which the ICC uses is furnished, basically, by the transportation industry which the ICC regulates. Any change in the direction of metrication would logically be initiated by these firms and they have shown no inclination to change.

A nationally planned program to promote metrication would entail substantial revision or republication of codes, rules, rate orders, tariffs, and schedules involving millions of pages. During the transition period of such a program, annual costs would be expected to increase by less than 1 percent. During the post-transition period, on the other hand, there would be a savings of less than 1 percent. The ICC estimates annual transition costs to total $70,000 ($30,000 for computer activities, $20,000 for clerical activities, and $20,000 for administrative activities) and annual post-transition savings to total $5,000 (for clerical activities). Cost decreases and operational improvement are estimated to be the long-term advantages of conversion to metric units of measurement.

3. Impact of Metrication on Transportation, ICC's Area of National Responsibility. The ICC estimates that the metric system is currently used in less than one-fourth of the Nation's transportation activities. No trends in metric usage are discerned. The impact of increasing domestic and international use of the metric system upon U.S. transportation activities is estimated by the ICC to be *negligible*.[1] The transportation industry has no inclination to adopt the metric system and does not appear to have been influenced by it.

Assuming no concerted national action to promote increased use of the metric system, the ICC thinks there will be little change from the present system by U.S. transportation activities.

If there were a nationally coordinated program to increase use of the metric system over a 10-year period, the ICC estimates that changes in equipment (scales, speedometers, etc.), supplies (packaging), and standards (maps, speed limits, load limits, etc.) would be required. The ICC thinks the primary advantage of metrication would be ease of mathematical manipulation.

To date, increasing domestic and international use of the metric system is estimated by the ICC to have had no impact on its ability to perform its mission with respect to the transportation industry. The ICC thinks that adoption of the metric system would probably improve its effectiveness in its dealings with the transportation industry.

In the event of metrication, an enormous volume of tariffs and schedules on file with the ICC would have to be republished by the transportation industry. Similarly, outstanding rate orders, Commission rules and regulations, operating authorities containing mileage or weight limitations, and cost formulas would be affected. Reports and data filed with the Commission involving ton-miles or vehicles-miles would have to be revised, especially where continuity of data is important. These problems are in addition to more routine problems such as the standardization of sizes and dimensions for supplies and equipment.

Advantages of metrication are less easily defined. There would certainly be an advantage of increased efficiency but this is not easily reduced to dollars and cents. As an additional benefit, metrication would encourage thoughtful consideration as to the maintenance or retention of files, reports, etc., which are of marginal utility, particularly obsolete tariff publications.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

4. Conclusion. From the standpoint of the ICC, the necessity for conversion to the metric system does not seem compelling within any particular time frame. Justification for metrication will result from changes initiating outside the transportation industry. The limited experience of the ICC with the metric system, directly or indirectly, restricts its ability to respond to the issue of metrication other than by conjecture. The ICC's response to conversion to metric usage is, therefore, "no position."

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

Liaison Representatives:

Milton W. Rosen, Office of DOD and Interagency Affairs; and Edward J. Brazill, Director, Technical Staff, MCL

Respondents — Internal Operations:

I. Ames Research Center, Moffet Field, California
  1. Deputy Director

II. Flight Research Center, Edwards, California
  1. Directorate of Biomedical Programs
  2. Data Systems Division
  3. Fabrication Shops, Operations Division
  4. Operations Engineering

III. Goddard Space Flight Center, Greenbelt, Maryland
  1. Administration and Management Directorate

IV. Jet Propulsion Laboratory, Pasadena, California
  1. Plans and Programs Division
  2. Data Systems Division
  3. Space Sciences Division
  4. Telecommunications Division
  5. Guidance and Control Division
  6. Engineering Mechanics Division
  7. Astrionics Division
  8. Environmental Sciences Division
  9. Propulsion Division
  10. Mission Analysis Division
  11. Tracking and Data Acquisition
  12. Research and Advanced Development
  13. Quality Assurance and Reliability Office
  14. Supporting Facilities Office
  15. Technical Facilities Office
  16. Plant Engineering Division
  17. Fabrication Services

V. John F. Kennedy Space Center, Kennedy Space Center, Florida
  1. Design Engineering — Mechanical Systems Division
  2. Design Engineering — Electronic Systems Division
  3. Technical Support Division
  4. Launch Operations (LLOPN2)
  5. Launch Vehicle Operations (LV)

6. Spacecraft Operations, LS Engineering
7. Data Systems Division
8. Unmanned Launch Operations – Facilities Liaison Office
9. Medium Launch Vehicle Division

VI. Langley Research Center, Hampton, Virginia

1. Structures Research Division
2. Engineering and Technical Services Division

VII. Lewis Research Center, Cleveland, Ohio

1. Office of the Director

VIII. Manned Spacecraft Center, Houston, Texas

1. Information Systems Division, Engineering and Development
2. Propulsion and Power Division, Engineering and Development
3. Medical Research and Operations Directorate
4. Technical Assistant for Apollo, Flight Operations
5. Advanced Planning Support Office, Flight Operations
6. Landing and Recovery Division, Flight Operations
7. Mission Planning and Analysis Division, Flight Operations
8. Space Physics Division, Science and Applications
9. Reliability and Quality Assurance Office

IX. George C. Marshall Space Flight Center, Marshall Space Flight Center, Alabama

1. Office of the Director

X. Wallops Station, Wallops Island, Virginia

1. Administrative Officer

1. Mission of the National Aeronautics and Space Administration (NASA). The purpose of NASA is to carry out the policy of Congress that activities in space should be devoted to peaceful purposes for the benefit of all mankind. The principal statutory functions of NASA are as follows:

1. expand human knowledge of phenomena in the atmosphere and space;
2. conduct research for the solution of problems of flight within and outside the earth's atmosphere, and develop, construct, test, and operate aeronautical and space vehicles;
3. conduct activities required for the exploration of space with manned and unmanned vehicles;
4. arrange for the most effective utilization of the scientific and engineering resources of the United States with other nations engaged in aeronautical and space activities for peaceful purposes; and

5. provide for the widest practicable and appropriate dissemination of information concerning NASA's activities and their results.

Planning, coordination and control of NASA programs are vested in Headquarters. Directors of NASA's Field Centers and other installations are responsible for execution of NASA's programs, largely through contracts with research, development, and manufacturing enterprises. A broad range of research and development activities is conducted in NASA's Field Centers and installations by Government employed scientists, engineers and technicians to evaluate new concepts and phenomena and to maintain the competence required to manage contracts with private enterprises.

Brief explanations of the responsibilities and activities of the Field Centers follow.

John F. Kennedy Space Center: Provision of supporting activities for the major launchings; preparation and integration of space vehicles.

Manned Spacecraft Center: Development of manned spacecraft, such as Apollo; development of life support systems; development and integration of experiments for assigned space flight activities; astronaut training; manned flight operations in space; and supporting scientific, engineering and medical research.

George C. Marshall Space Flight Center: Development of launch vehicles and systems to launch manned and unmanned spacecraft; development and integration of experiments for assigned space flight activities; and supporting scientific and engineering research.

Goddard Space Flight Center: Scientific research in space with unmanned satellites; development of earth observing, meteorological, and communications satellites; tracking and data acquisition operations.

Jet Propulsion Laboratory (Operated under contract by the California Institute of Technology): Deep space, lunar, and interplanetary scientific exploration; development of unmanned lunar and interplanetary spacecraft; operation of related tracking and data acquisition systems.

Wallops Station: Launch facilities and services for other NASA installations which conduct suborbital, orbital, and space probe experiments with vehicles ranging from small rockets to the Scout four-stage solid fuel rocket. Development of techniques for collection and processing of experimental data.

Ames Research Center: Basic and applied research in space environmental physics, including simulation techniques; gas dynamics research at extreme speeds; configuration, stability, structures, and guidance and control of aeronautical and space vehicles; biomedical and biophysical research.

Flight Research Center: Research in high performance aircraft and spacecraft, including flight operations and flight systems, and structural characteristics of aeronautical and space vehicles.

Langley Research Center: Research in aeronautical and space structures and materials, aerodynamics of re-entry vehicles, space environmental physics, life sciences, and subsonic and supersonic flight; and development of spacecraft for lunar and planetary exploration.

Lewis Research Center: Research in powerplants and propulsion, high energy propellants, nuclear rockets, and electric propulsion; management of medium launch-vehicle programs.

Because of the high technical content involved in NASA's mission, most activities within NASA would be affected by metrication. This would be especially true within the basic and applied research areas; the development, testing, and evaluation activities; operations; and plant and support facilities.

2. Present Metric Usage. Metric measurement units are used at all NASA Field Centers.[1] Metric engineering standards are used at eight of the 10 Centers (Langley Research Center and Wallops Station are the exceptions). The most widespread uses of the metric system within NASA are in basic research, laboratory analyses, electronics, fluid mechanics, in certain hardware (such as optical equipment), and in areas where international programs are important. Major reasons cited for *present* metric usage (except in those areas where metric usage is consistent with general practice) are improved international cooperation and operational improvement; cost savings are cited infrequently. Most basic research equipment is in the metric system. Metric usage is rare in the fabrication trades, mechanical engineering design areas, technical and support facilities, and plant engineering groups.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Under this assumption, there are some activities at each of the 10 Centers (except for Wallops Station) in which metric usage will increase. Two of the most significant changes forecast are: (1) significant increases in the use of metric units at all Centers, particularly in reports[2] and calculations, and (2) new instrument specifications to be completely metric by 1980 at the Lewis Research Center. Reasons for the increased metric usage are: science and engineering activities in many fields favor the metric system; quality and performance will be improved by increased metric usage; and the influence of international activities on NASA will increase. Lewis Research Center believes that a changeover to the metric system is inevitable within a generation and that some purchases of equipment should be in metric in order to reduce the cost of an eventual changeover.

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[1] NASA conducted a survey of its approximately 14,000 technical notes and technical memoranda reports published during the period 1962 through 1969 in order to determine the trend of metric usage in the NASA reports. The results showed that 22 percent of the reports contained metric units only; 31 percent contained English units only; 30.2 percent contained both units; and 16.1 percent contained neither English nor metric units. Comparison of the two four-year periods, 1962-65 and 1966-69 indicated that the combined metric usage (metric, predominately metric, and parallel usage) increased from 33.4 percent to 53.2 percent from the first four-year period to the second four-year period. See the report entitled "NASA Metric System Study" (NASA Contractor Report – 1555, February 1970).

[2] A NASA Policy Directive (Issuance No. NPD 2220.4 of September 15, 1970) directed that measurement values employed in NASA scientific and technical publications shall be expressed in SI units, except for exempt classes spelled out in the Directive.

Respondents in some other activities would like increased metric usage, but will not act unless there is a national program of conversion. These respondents feel that unless there would be a concerted action to go metric, it would not pay for their groups to unilaterally increase the use of metric beyond the requirements of the Policy Directive cited in the above referenced footnote.

Where individual respondents anticipate changes toward metric usage, most expect temporary cost increases. These will be caused primarily by the time and cost of retooling and redocumentation, revision and upgrading of techniques, training, and conversion of units. On the other hand, there will be some savings due to greater efficiency (e.g., less converting and checking).

Most individual respondents (36 out of the 44 responding) at all Centers except Ames Research Center believe that if the changes under Assumption I are not made, existing problems due to the dual systems will intensify—e.g., retraining, dual dimensioning, increased inventories, international communications, and conversion problems. There will be some failure of equipment and errors in manufacture due to incompatibility or discrete differences resulting from dual dimensioning.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Generally, NASA believes that metrication would increase costs to NASA during the transition period, but over the long run there would be savings under Assumption II.

Nine of the 10 Centers anticipate net annual added costs during the transition period (Ames Research Center foresees no cost impact). Net annual added costs for those respondents *giving dollar estimates* total about $711,000.

In addition to this figure, some individual respondents give descriptive estimates or percentage cost changes. For example, one group at the Manned Spacecraft Center anticipates "millions of dollars" of increased costs because of software conversion, training, and documentation. A few respondents at several of the Centers estimate percentage cost increases averaging about 10 percent. A center-wide estimate at Goddard indicates an expected increase of under 1 percent.

The increases are expected because of higher costs of fabrication, replacement of some equipment or parts, maintenance of dual inventories, changes in documentation, software conversion, some increase in errors and wastage, more accidents, changes in drawings, more dual dimensioning, recalibration, changes in nameplates on equipment, and training of personnel. Standard operating procedures would have to be reworked. Safety and building codes would have to be rewritten. Minor adjustments would be required in contracts.

Many individual respondents report that actual cost impacts would not be significant on their groups during the transition period because:

a. most hardware and documentation are supplied by other agencies;

b. most engineers and scientists are familiar with the metric system already; and

c. most present equipment based on English units will become obsolete and have to be replaced by the end of the transition period anyway.

During the post-transition period, there would be cost savings at all Centers except for Ames Research Center (no cost impacts) and Langley Research Center (uncertain if there would be any cost impacts). These costs savings would be due primarily to the benefits of working in a single, uniform system, which is implicitly simpler than the customary system. Thus, there would be fewer errors, elimination of conversion calculations, easier interchange of information, and elimination of the dual system in documentation and instrumentation. There would also be higher precision and greater reliability for measurement. The total annual net savings for those respondents *who give dollar estimates* is about $445,000. Again, several respondents give percentage savings or narrative descriptions of savings which are not included in this estimated figure.

There seems to be an implicit feeling that it would take a long time for the accumulated savings due to metrication to overtake the accumulated added costs during the transition, even though in the very long run, net costs savings are seen by most respondents.

Added costs do not seem to weigh significantly in the evaluation as to whether, in the long run, advantages would or would not outweigh the disadvantages. The predominant feeling at each Center (and that of 39 out of 46 individual respondents) is that the advantages of metrication would outweigh the disadvantages, primarily because of operational improvements.

Those individual groups which believe that the advantages would not predominate are the fabrications groups, technical and support facilities groups, and the launching groups at the Kennedy Space Center. These groups have heavy investments in customary hardware which would be costly to replace. The use of metric hardware in place of customary hardware would not significantly improve performance within these groups.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Measurement Units (Assumption III). The problems caused by metrication under Assumption III are somewhat similar to those under the prior assumption. The major difference is that a change in engineering standards would require more hardware type changes and difficulties in rewriting standards. There is more need to consider equipment life, replacement parts, interfacing between old and new equipment, and tooling. There would be a much greater problem regarding dual inventories.

Significantly fewer respondents give replies under Assumption III. In general, however, the answers under Assumption III parallel those given under Assumption II. Dollar estimates for annual added costs during the transition and the savings or added costs during the post-transition are generally the same as the estimates given under Assumption II.

All Centers except Ames Research Center (which expects no cost impact) anticipate increased costs during the transition. The total annual added cost during the transition for those respondents who give numbers of dollars is about $849,000. Not included in the $849,000 figure are respondents who give descriptive cost changes and who give percentage cost changes. For example, Goddard estimates that average annual costs would increase from 5 to 10 percent under Assumption III (whereas costs under Assumption II would increase under 1 percent.)

Most Centers expect slight savings after the transition period. During the post-transition period, the average annual net savings for the few respondents who give dollar figures total about $125,000. Only Goddard Space Flight Center expects net added costs during the post-transition.

Costs and savings figures imply, under Assumption III (as well as under Assumption II), that it would take decades for anticipated cumulative savings to overtake added costs accumulated during the transition period. Even if one discounts the future savings (no matter what reasonable discount rate one may suggest), NASA probably could not justify a case for going metric purely on these monetary savings estimates.

In spite of these indications that costs would increase in the near future because of metrication, the great majority of the respondents at NASA believe that advantages of going metric would outweigh disadvantages over the long term. Under Assumption III, 37 believe that advantages would predominate; four do not, and two do not know. This breakdown closely parallels that described under Assumption II. Those who believe that long term advantages would not predominate are the two facilities groups at Jet Propulsion Laboratory, the Engineering and Technical Services group at Langley, and Lewis Research Center (significant because Lewis thinks advantages would predominate under Assumption II).

Long term advantages cited are similar to those under Assumption II: namely, operational improvement and international convenience and cooperation. It is extremely difficult, if not impossible, to estimate savings that would result from these advantages. Advantages listed under Assumption III, but not under Assumption II, are: the possibility of a set of unified international engineering standards, possible generation of new and better standards, and reduction of inventories to metric sizes only.

Disadvantages cited under Assumption III are cost increases, use of older equipment difficult (in many cases), and operational impairment in several technical support and fabrication areas. Lewis Research Center notes that the Government would probably have to pay the costs of metrication for industry.

6. Conclusion. Nine of the 10 Centers are substantially in favor of a concerted national program to increase metric usage. Ames Research Center is undecided. Manned Spacecraft Center, Jet Propulsion Laboratory, and Marshall Space Flight Center make positive recommendations to convert to the metric system.

Thirty-seven individual respondents favor a national program, eight do not, and one does not know. Those groups not in favor of a national program are the fabrications groups, the technical support activities, and the launch facilities at Kennedy Space Center. Their large investments in hardware would have to be substantially modified, and the expected resulting performance would not be a noticeable improvement over the present performance.

Most respondents believe that metrication should come under a national program consisting of:

(1) legislation to make use of metric mandatory;
(2) use of metric in government specifications and contracts;
(3) educational and retraining efforts to teach metric; and
(4) publicity programs to acquaint the public with use and advantages of the metric system.

To make the changeover more effective, the Centers would (1) use their authority to issue management directives requiring the metric system to be used internally and (2) amend procurement contracts and grants to require metric use in procured hardware and software as well as in funded studies and research. Most documents and data formats would be in metric. Machine tools and equipment would be converted, where necessary, and some test equipment would have to be recalibrated or modified. Some new tools and equipment would have to be purchased.

To implement the changeover, in addition to the exercise of authority as stated above, the Centers would change design drawings along with standards and specifications; issue directives concerning training, publicity, and enforcement; and establish procedures to insure overall management visibility and control. JPL suggests setting up a planning and control board for the changeover effort.

Eight of the 10 Centers prefer a 10-year transition period. Both Marshall Space Flight Center (1-2 years transition period) and Lewis Research Center (does not specify length of transition period) favor a shorter transition period. Most of the individual respondents wanting a different period believe that metrication could be completed in less time; this would reduce the period of confusion. The three individual respondents wanting a longer period cite long retraining periods and costly replacement of plant and equipment (Plant Engineering Division and Telecommunications Division at the Jet Propulsion Laboratory and the Medium Launch Vehicle Division at the Kennedy Space Center).

If there were a concerted national program to use metric standards as well as measurement units, however, the Jet Propulsion Laboratory would prefer a 15-year period. Under these circumstances, Lewis believes that transition should vary from 5 to 15 years depending on the particular Center activity involved.

The intensity of impact on NASA from metrication under either Assumption II or III would be somewhere between *moderate*[3] and *substantial*, but in the main the changeover would be desirable. Any positive step to change over to the metric system would have to be a matter of national policy, and NASA's position would be influenced by the national policy.

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[3] See "Classification of Intensities of Impact" scale on p. 79.

NATIONAL SCIENCE FOUNDATION (NSF)

Liaison Representative:

Emanuel Haynes, Acting Head, Office of Plans and Analysis

Respondents — Internal Operations:

1. Assistant Director for Institutional Programs
2. Assistant Director for Education
3. International Decade of Ocean Exploration
4. Office of Computing Activities
5. Office of National Centers and Facilities
6. Office of Sea Grant Programs
7. Assistant Director for Administration
8. Office of Economic, Manpower and Special Studies

Respondents — Science and Technology Area of National Responsibility:

1. Office of Plans and Analysis
2. Senior Staff Associate, Research
3. Special Assistant, Education

1. Mission of the National Science Foundation. The fundamental mission of the National Science Foundation (NSF) is to institute and support basic scientific research and programs to strengthen scientific research potential in the mathematical, physical, medical, biological, engineering, social, and other sciences. The Foundation initiates and supports research programs relating to the development of marine resources. The Foundation awards grants and contracts primarily to universities and other nonprofit institutions in support of scientific research; awards grants to assist colleges and universities in improving their scientific capabilities; supports national centers, such as Kitt Peak National Observatory, where large facilities are made available to qualified scientists; awards graduate fellowships in the sciences; develops programs aimed at improving scientific education in the United States; supports the development and use of computers, primarily for research and education in the sciences; and encourages the interchange of scientific information among scientists of the United States and foreign countries. The Foundation develops and disseminates information relating to scientific manpower and resources.

2. Present Metric Usage. To a limited extent, metric measurement units are used in scientific documentation within NSF. Oceanographic data is in metric units and metric units are used in the five national centers supported by NSF. The metric system is used in NSF primarily because most scientific activities use metric units as general practice. There are no significant disadvantages within NSF in the use of the metric system.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). There appears to be no detectable trend toward increased metric usage in NSF. None of the respondents foresee further changes toward increased metric usage in the future. There is some concern expressed that problems will arise if there is no further increase in metric usage in NSF (e.g., in the training and international cooperation areas), but these problems are not seen as significant.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). NSF respondents anticipate very little impact on their activities under this assumption. Some current technical documentation would have to be converted to metric units. Grantees would be required to use metric units in their reports.

There are no foreseeable problems for NSF itself, though there may be problems and cost impacts for grantees. No cost impacts on NSF agency activities are anticipated. Several long-term advantages to NSF from metrication are cited. These include operational improvement, facilitated international communication and cooperation, and better promotion of U.S. standards internationally.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement. Since most activities in NSF are not directly concerned with standards, impacts on most internal operations of the agency would be identical to those described under the prior assumption. One exception is that grantees would be required to use metric standards, as well as metric measurement units, in their work in the field or in the laboratory. The other exception is that there would be a cost increase of about $300,000 per year, or under 1 percent, for the Office of National Centers and Facilities in order to make equipment changes at each of the Centers. No cost impacts are anticipated after the transition period, however.

6. Conclusion. Generally, a concerted national program to increase metric usage in measurement units and engineering standards is favored within NSF. Those wanting a concerted program suggest Congressional action followed by public education and introduction of the metric system into government operations. A 10-year transition period seems to be satisfactory. Though the proposed changes would not be needed as far as the internal operations of NSF are concerned, society would benefit.

Impacts of Metrication on Science and Technology

Present Metric Usage. At present the metric system is used in about 90 percent of all scientific activities and from one-quarter to one-half of all technological activites in the United States. There is increasing metric usage in engineering research and development, but little change in education and engineering design work.

Up to the present, the impact on science and technology of increasing worldwide and domestic metric usage has been *trivial.*[1] Whereas scientists already use the metric system, engineers, by and large, still use the customary system of units. The metric system is now widely taught in schools and colleges.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

Future Impacts of Metrication. Assuming no concerted national action to increase metric usage, there will be little effect on the work of scientists from the evolutionary increase in metric usage. If all other countries are metric, and dual systems continue to be used in the U.S., handbooks will eventually require conversion, standard plans will need adjustment, and measuring instruments will need changes in scales. A difficult situation could arise in early science education. There will, however, be *negligible* impact on the ability of NSF to perform its mission with respect to the areas of science and technology.

If there were a nationally planned program to increase metric usage over a 10-year period, there would be advantages in the long run and some short run disadvantages for science and technology. Long-term advantages would be uniformity and simplification. There would be disadvantages in the transition period with respect to the resistance to change. Costs would be relatively small since conversion of handbooks and charts could be incorporated in new editions. If the transition period were longer, costs might be smaller for conversion of books and charts, but the impacts would basically be the same.

NSF believes that adoption of the metric system would improve its effectiveness in coping with its responsibility toward science and technology. Science, engineering, and education could be better coordinated. People would learn to think in metric units. Simplicity and increased accuracy would result.

What Action Should Be Taken? NSF thinks that there should be positive action to change to the metric system. Scientific research and technological development would benefit as well as science education. NSF would not be significantly affected.

SMALL BUSINESS ADMINISTRATION (SBA)

Liaison Representatives:

Richard Hellman, Director of Economic Planning and Research; and Andrew Canellas, Acting Chief, Economic Planning Group, Office of Planning Research and Analysis

Respondents — Internal Operations:

1. Procurement Assistance (Boston), Certificate of Competency Program
2. Procurement Assistance (New York), Certificate of Competency Program
3. Procurement Assistance (Atlanta), Certificate of Competency Program
4. Procurement Assistance (Chicago), Certificate of Competency Program
5. Procurement Assistance (Dallas), Certificate of Competency Program
6. Procurement Assistance (San Francisco), Certificate of Competency Program
7. Procurement Assistance, Office of Business Development
8. Procurement Assistance, Office of Business Development
9. Management Assistance, Counseling Division
10. Management Assistance, Counseling Division
11. Procurement Assistance, Research and Technology Assistance Division

Respondents — Small Business Area of National Responsibility:

1. Counseling Division
2. Technology Utilization Officer
3. Research and Technology Assistance Division

1. Mission of the Small Business Administration. The mission of SBA is to aid, counsel, assist, and protect the interests of small business concerns; to insure that a fair proportion of the total Government purchases and contracts for supplies, services, research, and development be placed with small business enterprises; to make loans to small business investment companies and State and local development companies; to guarantee the payment of rent under leases to small business concerns to enable them to obtain prime commercial or industrial facilities; to license and regulate small business investment companies; to improve the management skills of the owners of small business concerns with direct action programs and through established channels of business relations; and to provide for the development of management skills of qualified persons seeking to establish a business.

2. Extent of Present Metric Usage. Currently, metric units of measurement or metric engineering standards are used by only two of the 11 SBA respondents. A respondent from the Office of Business Development uses metric units in the handling of contract assistance for drugs and pharmaceuticals, and in chemical contracts. The Research and Technology Assistance Division uses metric units in research and development contract assistance; metric engineering standards are used wherever they are prescribed by Federal standards and always with their equivalents under the customary system.

Use of SI by related scientific activities is cited as the reason for present metric usage; no disadvantages are mentioned.

3. Anticipated Changes If There Is No National Plan for Metrication (Assumption I). Under this assumption, none of the 11 SBA respondents plan to unilaterally increase use of the metric system. In the absence of any moves toward metrication, five SBA respondents, four from the Certificate of Competency Program and one from the Counseling Division, anticipate problems. Training is the most frequently mentioned problem, because of the increasing metric usage outside of SBA.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurment Units (Assumption II). Under this assumption, only one of the 11 SBA respondents anticipates savings or increased costs during the transition and post-transition periods; the remaining respondents anticipate no cost impacts.

One of the respondents from the Office of Business Development expects a 5 to 10 percent increase in annual added costs during the transition period under this assumption. During the post-transition period, annual internal savings of 5 to 10 percent are expected.

Three SBA respondents (both respondents of the Office of Business Development and one respondent of the Certificate of Competency Program) mention long-term advantages of metrication. International promotion of U.S. standards and improvement of international communication are the most frequently mentioned advantages. One respondent of the Certificate of Competency Program thinks adoption of metric units would mean cost increases and operational impairment.

Four respondents feel that the advantages of the changeover would outweigh the disadvantages. Two respondents believe that the disadvantages carry more weight, while four are unable to decide.

If there were a nationally planned effort to adopt metric units of measurement, only one respondent (one of those in the Office of Business Development) foresees significant problems. These would consist of substantial changes in laws and codes and problems in operations and in education and training. To implement a transition to metric units, three respondents mention training personnel in metric usage; the Counseling Division would have to revise manuals and publications in its field; and the Research and Technology Assistance Division would have to advise small businesses to carefully examine the language of specifications and contracts.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Meas-

urement (Assumption III). Under this assumption, SBA would face the same costs, savings, advantages, disadvantages, and problems of transition as under the prior assumption.

6. Conclusion. Of the 11 SBA respondents, six[1] recommend adoption of metric units of measurement and four[2] recommend adoption of metric engineering standards. Three are opposed to the adoption of metric units and standards; these are: two of the Certificate of Competency Program respondents, and the Research and Technology Assistance Division respondent. The remaining respondents make no recommendations.

The respondents who favor metrication submit a wide range of recommendations. These include: formation of a "blue ribbon" committee, representing all strata of our culture, to develop procedures to expedite metrication; international agreements on metrication; mandatory dual measurements with immediate movement toward metrication; a national program of metric education; and a national plan of metric implementation.

The respondents who advise against metrication anticipate a number of problems. Problems foreseen by two of the respondents are as follows:

(1) A respondent from the Certificate of Competency Program said that the costs of conversion to the metric system would be substantial for small businesses and metrication could result in a less competitive position for small businesses relative to that of larger businesses.

(2) A respondent from the Certificate of Competency Program said that a transition to the metric system would result in more competition from abroad for the small tool and machine manufacturers without an offsetting increase in exports due to our traditionally high production costs.

Concerning a preference for a longer or shorter period than 10 years for metrication, three respondents reply "no" and one "yes." Five respondents are unable to estimate the adequacy of a 10-year transition period; two respondents do not respond to this question. One respondent of the Counseling Division recommends a transition period of 2 years because it would reduce conversion and double measurement costs. However, he is unable to estimate the extent of these cost reductions.

Impacts of Metrication on Small Business

Present Metric Usage. At present, the metric system is used in less than one-quarter of all activities in the small business area. Small companies involved with research and development use the metric system in some activities but tend to use customary units and standards in their contracting work. At present, it does not appear that there is a trend toward increased metric usage in the small business area.

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[1] These are: two of the Certificate of Competency Program respondents, two of the Office of Business Development respondents, and both of the Counseling Division respondents.

[2] These are: one of the Certificate of Competency Program respondents, two of the Office of Business Development respondents, and one respondent from the Counseling Division.

Increasing domestic and international use of the metric system has had a *negligible*[3] to *trivial* impact on the Nation's small businesses. The bulk of the products produced by the Nation's small businesses are consumed by the Government or domestic firms (both use customary units of measurement and standards). Only small businesses serving foreign markets have been affected.

Future Impacts of Metrication. Increasing use of the metric system without a coordinated national program for its adoption might have serious consequences for small businesses. Without Federal assistance, small businesses would tend not to move towards metrication as readily as the Government and larger industries, and might be put at a competitive disadvantage. Metrication would help a limited number of small manufacturers sell abroad but this advantage would probably be offset by the *substantial* to *severe* costs of transition which small manufacturing firms would face.

Under a nationally coordinated program of metrication with a 10-year transition period, a Federal program of assistance would be helpful for small businesses. Retail and service industries would probably require a modest program of assistance. Small manufacturing firms would want a more comprehensive program of assistance since they would face substantial costs of conversion and more serious problems of transition.

With regard to the duration of the transition period, one respondent (Counseling Division) would like to see the shortest one possible since this would be the cheapest in terms of conversion costs. Another respondent (Technology Utilization Officer) thinks a transition period longer than 10 years (but not exceeding 20 years) would have a more moderate impact on the industries involved.

The Technology Utilization Officer also suggests that the magnitude of foreign exports by small U.S. producers be used as a numerical indicator of the impact of metrication on small businesses.

Increasing domestic and international use of the metric system has had a *negligible* impact on the ability of the Small Business Administration to perform its mission with regard to the Nation's small businesses. It is unclear whether or not metrication would improve the Small Business Administration's effectiveness with regard to its responsibilities.

What Action Should Be Taken? In the event of a nationally coordinated program of metrication, the respondents of the Small Business Administration recommend programs of assistance for the Nation's small businesses and the teaching of the metric system in our entire educational system.

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[3] See "Classification of Intensities of Impact" scale on p. 79.

SMITHSONIAN INSTITUTION

Liaison Representative:

Henri E. Mitler, Astrophysical Observatory

Respondents – Internal Operations:

1. Office of the Assistant Secretary
2. Office of Assistant Secretary (Science)
3. Environmental Sciences
4. Department of Science and Technology, Museum of History and Technology
5. Division of Cultural History, Museum of History and Technology
6. Department of Applied Arts, Museum of History and Technology
7. Division of Postal History, Museum of History and Technology
8. Division of Textiles, Museum of History and Technology
9. Department of Industries, Museum of History and Technology
10. Division of Military History
11. National Zoological Park
12. Buildings Management Department
13. Chief of Exhibits, Buildings Management Department
14. Arts Exhibits, Buildings Management Department
15. Astrophysical Observatory
16. Conservation – Analytical Laboratory
17. Radiation Biology Department

1. Mission of the Smithsonian Institution. The Smithsonian Institution is an independent establishment devoted to public education, basic research, and national service in science, the humanities, and the arts. The Institution administers a number of Government programs placed under its control by the Congress and funded by Federal appropriations. The Institution itself is a private, nonprofit corporation. It receives and administers contracts and grants and accepts gifts and bequests from both private and public sources. These activities are administered in its capacity as a private organization.

The Smithsonian Institution's collections, libraries, and laboratories are unique resources for research and information. The Institution maintains museums of science, history, and technology, art galleries, a zoological park, an observatory, and research laboratories, natural preserves, and information handling facilities. The Institution performs fundamental research and publishes the results of studies, explorations and investigations.

2. Extent of the Present Metric Usage. Most of the responding divisions in the Smithsonian already use metric measurement units in their activities. Of the people in the Institution who make measurements, 80 to 90 percent make them in metric units. Metric units are used, for example, in the measurement of zoological specimens, in analytical and other laboratory measurements, in oceanographic research, in measuring dimensions of paintings and sculpture, and in areas dealing with museum items of foreign manufacture.

Only two divisions report usage of metric engineering standards. The Museum of History and Technology uses metric standards in the restoration of objects constructed in metric sizes. The Division of Postal History uses metric standards in the construction of materials related to research on stamps and other postal papers.

Most respondents who use the metric system do so because it is generally accepted procedure in their activities. Metric usage also facilitates international cooperation and communication. Only the Radiation Biology Department cites cost impacts (in this case, savings) due to present metric usage. No disadvantages to present metric usage are cited.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I.) Only three of the 17 respondents believe that their organizations will increase the use of the metric system in their activities under Assumption I. The Environmental Sciences group believes that its weight and volume measurements will be metric because of the need for greater accuracy of comparative measurements; but there is no time estimate as to when this will happen. The estimated cost impact resulting from the changes will be a one-time cost increase of 1 to 5 percent for training expenses. The Division of Cultural History predicts adoption of metric measurements for museum specifications and catalog data because of the increasing trend toward computerization of catalog data. The time and effort needed for correcting existing records will lead to a cost increase of less than 1 percent. The Division of Postal History, which already is largely metric, plans complete metric usage; but no date for total conversion is given.

Three of the 17 respondents anticipate problems if no changes toward metrication are made in their divisions under Assumption I. Problems are anticipated because of increased dual dimensioning.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). There seems to be a general consensus of opinion that a switch to the metric system would have little impact upon the Smithsonian Institution. Under Assumption II, there would be an annual cost increase for the Smithsonian Institution of less than $25,000 during the transition period, and negligible cost increase after the transition. Four out of the 17 responding Divisions expect increased costs during the transition period; no respondents anticipate any savings during the transition. The Radiation Biology Department expects a cost increase of $2,200 per year or 5 to 10 percent because of additional expenses for office and shop needs. The Environmental Sciences group foresees increased costs of $10,000 per year (1 to 5 percent) during the transition. The Division of Military History expects costs increases of 10 percent or over ($900 to $1,500 per year) due to increased cataloging expenses. The Buildings Management Department foresees increased costs of $10,000 per year (under 1 percent) for its operations activities.

For the post-transition period, only one Division expects cost impacts arising from metrication under Assumption II. The Division of Military History expects a cost increase of 10 percent or over ($900 to $1,500 per year) during the post-transition period as well as during the transition period.

Most respondents believe that there would be long term advantages for their operations resulting from metrication under Assumption II. Most frequently mentioned advantages are simplified measurements and calculations, operational improvement, and better promotion of U.S. standards internationally. Improved facility for international transfer of information, comparisons of measurement, and data handling and storage in computers are also advantages. Ease of communication between shop people and scientists is mentioned by the Radiation Biology Department as a long term benefit. Only the Buildings Management Department mentions any long term disadvantages to metrication under Assumption II. In that case, cost increases and operational impairment within the Department are anticipated as a result of training, inventory, and conversion activities.

Most respondents believe that the advantages of metrication under Assumption II would outweigh the disadvantages. Only two (both in the Buildings Management Department) feel that the advantages would not outweigh the disadvantages.

Only two of the responding Divisions of the Smithsonian Institution foresee any significant problems which would arise under Assumption II. The Buildings Management Department believes that there would be problems concerning operations, maintenance and equipment, and training. One critical problem would be the necessity of increased monitoring of employees' work to guard against a likely increase in the number of errors until the employees are familiar with the system. The respondent in the Buildings Management Division dealing with arts exhibits believes that there would be problems dealing with maintenance, equipment, and training.

Only eight Divisions provide any comments with regard to what needs to be done in implementing the changeover. Most of the needed tasks would involve the training of employees. Only the Radiation Biology Department and the Buildings Management Department mention more involved implementation tasks. Both would have to replace some equipment and supplies. The Buildings Management Department, however, would also have to substantially increase its inventory of items.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). Under this assumption the impacts upon the Smithsonian Institution would not be much different than they would be under the prior assumption. More hardware would have to be changed and this would involve several thousand more dollars than would be involved under Assumption II.

Only three of the 17 Divisions see any significantly different impacts under Assumption III than they see under Assumption II. The Astrophysical Observatory believes that there would be a cost increase of under 1 percent during the transition period under Assumption III (about $300 per year for retooling and replacement of micrometers and other instruments), whereas there would be no cost impact under the prior assumption.

The Radiation Biology Division says that an additional benefit of conversion under Assumption III would be the facilitated evaluation of products of U.S. and foreign origin. The Director of the Buildings Management Department believes that under Assumption III, there would be an annual cost increase of $17,500 ($7,500 annually for engineering and design activities and $10,000 for operating activities); no cost impacts are anticipated during the post-transition. These estimates contrast with the anticipated cost increases under Assumption II ($10,000 annual increase during the transition).

Most respondents believe that the advantages of metrication under Assumption III would outweigh the disadvantages. Two (both in Buildings Management Department) believe that the advantages would not outweigh the disadvantages.

6. Conclusion. There is general approval within the Smithsonian Institution for conversion to the metric system. Eleven[1] of the 17 respondents favor a nationally coordinated plan to increase the use of metric measurement units and engineering standards. The Director of the Buildings Management Department does not favor a concerted plan. The other respondents either do not provide an opinion or do not know.

The following types of concerted action are suggested: public education in the metric system, governmental usage of metric, training in all government agencies, and Congressional action based on recommendations of the National Bureau of Standards.

Few of the respondents give any opinion as to the optimum length of the transition period. Three (Division of Postal History, Division of Military History, and Art Exhibits) believe that a 10-year period would be satisfactory. Three others (Astrophysical Observatory, Radiation Biology Department, and Environmental Sciences) believe that a 5-year period would be long enough. The shorter the transition period, in their opinion, the shorter is the period of confusion inherent in a dual system. .

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[1] These are: Astrophysical Observatory, Conservation-Analytical Laboratory, National Zoological Park, Radiation Biology Department, Environmental Science, Department of Applied Arts, Division of Postal History, Division of Military History, Division of Cultural History, Office of Assistant Secretary (Science), and Arts Exhibits.

TENNESSEE VALLEY AUTHORITY (TVA)

Liaison Representative:

Reed A. Elliot, Director of Water Control Planning

Respondents — Internal Operations:

1. Office of Power
2. Office of Engineering Design and Construction
3. Office of Agriculture and Chemical Development
4. Maps and Survey Branch
5. Division of Water Control Planning

Respondents — Energy Area of National Responsibility:

1. Assistant Manager of Power, Office of Power
2. Power Research and Development Branch, Office of Power

Respondent — Environmental Pollution Control Area of National Responsibility:

1. Division of Environmental Research and Development, Office of Health and Environmental Science

1. Mission of the Tennessee Valley Authority. TVA is a corporate agency of the U.S. Government, established in 1933 to develop the Tennessee River System and to assist in the development of other resources of the Tennessee Valley and adjoining areas. This comprehensive development program includes flood control; navigable waterways; electric power production; fertilizer research and agricultural development; environmental research and management; forestry, fish, and wildlife resources; and related activities.

2. Extent of the Metric Usage. At present the metric system is used in all nuclear power plant core and fuel measurements and calculations. Metric-based engineering standards are used in planning and procurement of nuclear steam plant components and fuel. Most chemical, metallurgical, biological, medical, and photographic laboratory equipment and instruments are calibrated in the metric system. Therefore, in most laboratory operations metric measures are used.

Certain surveying, topographic mapping, photogrammetric, and other engineering equipment, especially those of foreign manufacture, are calibrated in the metric system. Certain scientific and engineering laboratory equipment and instruments are calibrated in the metric system. Most foreign manufactured power plant and transmission plant equipment are designed in metric measures.

The activities dealing with the planning, design, and construction of nuclear power plants in TVA have had increasing metric usage to a considerable degree since about 1964. Because of the increase in the purchase of foreign designed and manufactured power generating, transmission, and distribution equipment, there has been an increasing involvement with metric units. Increased international scientific and engineering involvement and cooperation by TVA employees has meant that metric usage is becoming more common, especially in the writing of papers presented at foreign technical meetings or published in journals and magazines that have international distribution. An increasing number of scientific and engineering equipment and instruments manufactured in the United States are being calibrated in the metric system. In a number of cases manufacturers no longer offer equipment calibrated in the customary system.

The chief advantages of present metric usage are facilitated international cooperation and better communication with related scientific activities. The Office of Power says that indirect cost savings result from purchases of foreign equipment built to metric standards.

The principal disadvantage is that use of a dual system of units and standards creates confusion, introduces errors and is more costly than use of a single system. Lack of familiarity has necessitated the training of engineering personnel. Another disadvantage is that industry and the engineering profession tend to prefer customary units.

The TVA believes that in general the advantages of present usage outweigh disadvantages.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). None of the five responding offices in TVA anticipate any changes toward increased use of the metric system, without concerted national action. Four of the five respondents say that if the offices make no changes, problems would ensue because of the increasing metric usage outside of TVA. Dual dimensioning and international cooperation problems, increased inventory, increased conversion, and increased interfacing are cited as anticipated problem areas.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). All five of the respondents anticipate cost impacts during the transition and the post-transition periods. During the transition period, cost increases and the reasons therefore are:

a. Office of Power anticipates a cost increase of $300,000 (1-5 percent)—$100,000 increases each for engineering, operations and maintenance, and training activities.

b. Office of Engineering Design and Construction anticipates a cost increase of $225,000 (1-5 percent)—$65,000 for design and $160,000 for construction.

c. Office of Agriculture and Chemical Development anticipates a cost increase of $225,000 (1-5 percent)—$200,000 for labor and $25,000 per year for parts.

d. Maps and Survey Branch anticipates a cost increase of $150,000 (5-10 percent)—$80,000 for cadastral, $10,000 for geodetic, $25,000 for topographic, $10,000 for hydrographic, and $25,000 for construction activities.

e. Division of Water Control Planning anticipates a cost increase of $50,000 (1-5 percent)—annual increases of $35,000 for laboratory, and $15,000 for field activities.

During the post-transition period, all but the Office of Agriculture and Chemical Development anticipate savings as follows:

a. Office of Power anticipates a net annual costs savings of $80,000 per year (less than 1 percent)—a savings of $100,000 for engineering activities, and an added cost of $20,000 for operations and maintenance.
b. Office of Engineering Design and Construction anticipates an annual savings of $100,000 (under 1 percent)—the activities in the Division of Engineering Design and the Division of Construction.
c. Maps and Surveys Branch estimates an annual savings of $40,000 (1-5 percent)—savings of $10,000 for cadastral, $5,000 for geodetic, $10,000 for topographic $5,000 for hydrographic, and $10,000 for construction activities.
d. Division of Water Control Planning expects annual savings of $15,000 (1-5 percent)—$10,000 for laboratory work and $5,000 for field work.

On the other hand, the Office of Agriculture and Chemical Development expects annual added costs of $35,000 (under 1 percent) because of additional labor costs.

In summary, under Assumption II, annual costs would increase by $1 million (1-5 percent) during the transition period and would decrease by $200,000 (1-3 percent) during the post-transition. Cost impacts would be greatest during the first several years of the transition period.

Following the transition period, operations cost reductions and improvement in the overall engineering and scientific activities would ensue. In addition, international communications and promotion of U.S. standards internationally would be improved considerably. The following specific advantages are foreseen: elimination of dual system; reduction in measurement and calculation errors; simpler conversion of units, better interchangeability of equipment and instruments, and common terminology for scientists and engineers.

The advantages of the changeover to the metric system would far outweigh the disadvantages.

In order to implement the changeover, TVA would have to train and educate personnel, revise most specifications and instructions, purchase new or modify existing equipment and instruments, and operate a dual system throughout the period of conversion.

Computer conversion to the metric system would require the changing of a large number of programs. There would be changes required for numerous tools and other maintenance equipment. Conversion of tables and graphs and the reissuing of specifications and information-type literature would be necessary. All survey markers and survey registers would have to be converted.

Other problems which would arise include the necessity for changes in State fertilizer laws, and changes in contracts, real estate descriptions, and engineering practice regulations. There would also be an increase in errors (and thus increased costs) because of the unfamiliarity with and the awkwardness of a dual system.

Interface problems would exist between parts manufactured in metric dimensions "retrofitted" to existing equipment. Parts inventory requirements would be increased during the transition period.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). Under this assumption the impacts of metrication on the TVA would be about the same as under the prior assumption. Costs would be somewhat greater under Assumption III. Annual added costs during the transition period would be as follows:

a. Office of Power anticipates annual increased costs of $400,000 (1-5 percent)–$100,000 for revising internal specifications and standards, $175,000 for operations and maintenance (including inventory items), and $125,000 for training activities.
b. Office of Engineering Design and Construction expects an annual cost increase of $400,000 (5-10 percent).
c. Office of Agriculture and Chemical Development anticipates an annual cost increase of $275,000 (1-5 percent)–$225,000 for labor and $50,000 for parts.
d. Maps and Survey Branch expects an annual cost increase of $200,000 (5-10 percent)–$100,000 for cadastral, $20,000 for geodetic, $30,000 for topographic, $20,000 for hydrographic, and $30,000 for construction activities.
e. Division of Water Control Planning expects a cost increase of $25,000 (1-5 percent) per year–$20,000 for laboratory and $5,000 for field activities.

During the post-transition period, three TVA respondents expect cost savings and two expect cost increases. Cost savings are expected as follows:

a. Office of Engineering Design and Construction expects an annual savings of about $150,000 (1-5 percent).
b. Maps and Survey Branch expects a savings of $50,000 per year (1-5 percent)–$15,000 for cadastral, $10,000 for geodetic, $10,000 for topographic, $5,000 for hydrographic, and $10,000 for construction activities.
c. Division of Water Control Planning expects a cost savings of $10,000 (1-5 percent) annually for laboratory work.

The two organizations expecting cost increases during post-transition are as follows:

a. Office of Power expects a cost increase of $60,000 (under 1 percent)—$30,000 for operations and maintenance and $30,000 for training.
b. Office of Agriculture and Chemical Development expects a cost increase of $50,000 (under 1 percent) because of labor and parts expenditures.

In summary, under Assumption III there would be an increase in the annual cost of TVA operations of 1 to 5 percent during the transition period and a savings following the transition period. The estimated annual cost increase is $1,300,000 during the transition period. The annual savings after the transition period is estimated at $100,000.

The long-term advantages and disadvantages under Assumption III are nearly identical to those described under the prior assumption. In addition, there would be advantages accruing from extensive international interchangeability of equipment and materials because of more uniform standards.

In implementing the changeover to the metric system under Assumption III, procedures would be substantially the same as described under the prior assumption. In addition, dual inventories would be required for some items, and machine tools and instruments would have to be replaced sooner than otherwise. TVA would have to assist in making necessary changes in regional State fertilizer laws. Also, TVA would need to stock more replacement parts.

6. Conclusion. In the overall view, the TVA would gain from a carefully planned and executed national program of metrication. Transition should be made as expeditiously as possible to reduce the total time during which a dual system and its consequences must be endured. A transition period shorter than the proposed 10 years can be accomplished at less cost, with less disruption, and with an earlier realization of benefits. For measurement units, a transition period of about 5 years appears adequate. For standards, a slightly longer period may be necessary.

Impacts Of Metrication on the Energy Field

Present Metric Usage. At present the metric system is used in less than one-quarter of the work activities in the energy field in the United States. Metric usage appears to be increasing because of increased contact with foreign manufacturers and suppliers and because of nuclear power generation.

The impact of current trends toward metrication on TVA's responsibilities in the energy field is seen as *trivial.*[1] In a limited number of areas, such as planning and procurement of nuclear plant components, laboratory testing and analysis, and increasing use of equipment and instrumentation of foreign manufacture, a dual system must be maintained. But most problems can be solved by using conversion charts.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

Future Impacts of Metrication. Assuming no concerted national action to increase use of the metric system, the slow and disorderly transfer to metric units that would result would lead to increasing and prolonged disruption inherent in the dual system.

If there were a 10-year nationally planned program to increase the use of the metric system, the phasing out of parts tooled in customary measurements in the energy field could create practical difficulties throughout the life of power plants. These problems would not be affected by the length of the transition period.

The adoption of the metric system via a nationally planned program would improve TVA's effectiveness within its area of responsibility toward energy. Uniformity with international measurements and standards should simplify and improve cooperation and communication with suppliers, scientists, and engineers abroad. The TVA doubts, however, that there would be a measurable impact on its ability to produce and transmit power.

What Action Should Be Taken? TVA believes that the National Bureau of Standards should move toward the adoption of metric standards. This should be done with the participation of professional and trade associations. Immediate conversion should be encouraged in those industries suffering no significant impact or incurring measurable benefits.

Impacts of Metrication on Environmental Pollution Control

Present Metric Usage. The TVA believes that within the pollution control field, the metric system is used in over three-quarters of all the work activities of health physicists and biologists; in between one-quarter and three-quarters of the work of the air and water quality engineers; and in less than one-quarter of the work of environmental engineers. Metric usage is increasing within the pollution control field, except within environmental engineering, where no trend is evident. Health physicists believe that their data is generated and displayed almost entirely in the metric system. For others active in air pollution control, except for the environmental engineers, a slow trend toward metric usage has been observed.

Impact of the current metric usage upon the pollution control area of responsibility is *negligible* as far as environmental engineers are concerned. Impact of the current trends toward metrication is seen as *trivial* according to the water quality engineers and health physicists. The air quality engineers and biologists class the impact as *moderate*.

Future Impacts of Metrication. If there were a nationally planned program to increase metric usage, TVA's effectiveness in performing its mission within the environmental pollution control field would be improved. Improved effectiveness is attributed to reduced chance of error in conversion, uniformity, and ease of reporting and interpreting scientific articles. However, environmental engineers believe their work might be impaired because of high conversion costs for maps and charts and for maintenance of a dual system in the interim. Major advantages of conversion are not affected by the length of the transition period.

What Action Should Be Taken? Except for the environmental engineers, TVA favors promotion and early adoption of the metric system.

U.S. INFORMATION AGENCY (USIA)

Liaison Representative:

Walter W. Jones, Chief, Management Division

Respondents – Internal Operations:

1. Office of Assistant Director (Broadcasting)
2. Office of Assistant Director (Information Centers)
3. Office of Assistant Director (Motion Pictures and Television)
4. Office of Assistant Director (Press and Publications)
5. Office of Assistant Director (Administration)

1. Mission of the U.S. Information Agency. The purpose of the USIA is to help achieve U.S. foreign policy objectives by influencing public attitudes in other nations, and advising the President, his representatives abroad, and the various departments and agencies on the implications of foreign opinion for present and contemplated U.S. policies, programs, and official statements. While the Director of USIA takes the initiative in offering counsel, the various departments and agencies can seek such counsel when considering policies and programs which may substantially affect or be affected by foreign opinion.

The Agency's mission is accomplished by the use of the various techniques of communication – personal contact, radio broadcasting, libraries, book publication and distribution, press, motion pictures, television, exhibits, English-language instruction, and others. Agency offices abroad, known as the United States Information Service (USIS), under the supervision of the Chiefs of Mission, conduct public information, public relations, and cultural activities – i.e., those activities intended to inform or influence foreign public opinion – for agencies of the U.S. Government, except for Commands of the Department of Defense.

2. Extent of Present Metric Usage. USIA, as a part of the foreign affairs community, has its attention and efforts directed to the rest of the world. At present, numerous offices of this Agency work and communicate using, in part, the metric system for measurements and engineering standards.

The Press and Publications Service uses metric measurement units in establishing specifications for the installation of radio antennae and communications equipment.

The Information Center Service uses metric measurement units and metric engineering standards for all drawings, detailing, renderings, and specifications for cultural exchange traveling exhibits designed for fabrication overseas, exhibitions and pavilions at international fairs, and itinerant panel exhibits. These are fabricated, duplicated, erected and tested overseas using metric measurement standards.

The Motion Picture and Television Service uses metric measurement units in motion picture film stock, motion picture and TV lenses, radio wavelength measurements, temperature parameters for electrical components, and electronic measurements. As to metric engineering standards, most U.S. motion picture-TV standards include both English and metric information, since they are used internationally.

The Broadcasting Service uses metric measurement units and engineering standards for the engineering and construction of radio facilities abroad to be used for international broadcasting as opposed to intra-Agency communication.

The use of metric measurements and standards facilitates the work of these offices. Indeed, the activities of certain USIA operations require the use of the metric system in order to arrange for necessary contractual services overseas.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). USIA plans no further usage of the metric system under this assumption.

4. Anticipated Impact Under a Nationally Coordinated Program to Increase Use of Metric Units (Assumption II). Conversion from the customary to the metric system in the United States would help simplify the work of the USIA offices. The general practice now is to convert to the metric system for overseas communications and working purposes, or to operate in a dual-system to provide for the full comprehension of American-educated officers and domestic contacts. Elimination of the need to convert to the metric equivalents or to provide dual-system information would result in economies of operation and manpower.

Total conversion to the metric system within a 10-year period would require the replacement of certain tools and reference books now in use. However, normal replacement during a 10-year period could accommodate such replacements with little or no additional conversion-created costs.

Certain existing facilities, particularly communications equipment, which were designed and built using English standards would require the expenditure of funds for conversion. However, the overall costs of such conversions are essentially minimal and would be offset by the subsequent reduction of operating and maintenance costs.

The greatest disruption which would be caused by conversion would be in the area of employee response to the change and in the need to re-educate personnel.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Units of Measurement (Assumption III). The impacts under this assumption are identical to those under the prior assumption.

6. Conclusion. The opinion of responsible Agency officers is that conversion, brought about by a planned program, would be to the overall advantage of the Agency.

U.S. POSTAL SERVICE

Liaison Representative:

Norman Roth, Special Assistant to Director of Design, Office of Design

Respondents — Internal Operations:

I. Bureau of Research and Engineering

1. Director, Office of Technical and Advanced Planning
2. Office of Technical and Advanced Planning
3. Industrial Engineering Staff
4. Standards Division, Industrial Engineering Directorate
5. Machines Control Branch, Mechanization Engineering Division
6. Mechanization Design Branch, Mechanization Engineering Division
7. Letter Mail Equipment Branch
8. Specifications
9. Technical Proposal Evaluation Staff
10. Office of Contract Programs
11. Engineering Support Branch

II. Bureau of Operations

1. Buildings Branch, Maintenance Division
2. Utilization and Requirements Division
3. Regional Management

III. Bureau of Facilities

1. Building Design Division
2. Utility Design Division
3. Construction and Coordination Division
4. Program Management

IV. Bureau of Chief Postal Inspector

1. Law Enforcement Science and Technology

V. Postal Service Management Institute

1. Engineering and Instruction Division
2. Engineering and Instruction Division

Respondent — Communications (Mail Delivery Operations) Area of National Responsibility:

1. Industrial Engineering, Office of Design

1. Mission of the U.S. Postal Service. The mission of the U.S. Postal Service is to collect and deliver the mail. The Bureaus most affected by metrication are described below.

The Bureau of the Chief Postal Inspector directs the execution of policies, regulations, and procedures governing all investigations; investigates all violations of postal laws and presents evidence of a criminal nature to the Department of Justice and U.S. Attorneys; and directs operating inspections and audits, including comprehensive internal and contract auditing, for the Postal Service.

The Bureau of Research and Engineering provides leadership for and directs research, development and engineering programs for the Postal Service. It is responsible for the development of new concepts, systems, and techniques for the processing, movement, and delivery of mail; preparation of basic equipment manning values; and development, design, and testing of postal equipment and materials.

The Bureau of Operations provides direction for the execution of policies, programs, regulations, and procedures governing the operational activities of the field postal service including the admissibility, makeup, classification, application of postage rates and fees, and collection, processing, dispatch, and delivery of mail.

The Bureau of Facilities formulates and administers policies, programs, and procedures governing the acquisition, management, maintenance, improvement, and disposal of postal space and of utilities, operating equipment, and supplies; procurement and primary distribution of accountable paper items; the production, repair, and storage of mailbag equipment; production of postal locks and keys; and the procurement, maintenance, storage, and disposal of postal vehicles. It provides architectural and engineering services for the design and construction of all new or enlarged postal facilities.

The Postal Service Management Institute develops and teaches courses to postal engineers, technicians, and management in areas of engineering management, especially as applied to the mechanization program.

2. Extent of the Present Metric Usage. Only five[1] of the 21 responding subdivisions in the U.S. Postal Service use metric measurement units at present and only three[2] use metric engineering standards. Present metric usage is confined primarily to areas in which equipment is usually made according to the metric system (communications devices, optical equipment, anti-friction bearings, photographic equipment, and equipment in the lighting and power areas). Much of the above equipment is foreign-made.

All five of the subdivisions which use the metric system identify no advantages except that "that's the way the equipment was made." Only one respondent cites any disadvantages; the Industrial Engineering Staff respondent names "lack of familiarization" as a disadvantage.

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[1] These are: Industrial Engineering Staff, and Specifications in the Bureau of Research and Engineering; Utility Design Division in the Bureau of Facilities; Law Enforcement Science and Technology in the Bureau of the Chief Postal Inspector; and Engineering Instruction Division in the Postal Service Management Institute.

[2] These are: Industrial Engineering Staff in the Bureau of Research and Engineering; Utility Division in the Bureau of Facilities; and Engineering Instruction Division in the Postal Service Management Institute.

3. Anticipated Changes if there is No National Plan for Metrication (Assumption I). Only three of the 21 respondents believe that their subdivisions will increase use of the metric system in their activities under Assumption I. Two of these respondents plan significant changes toward greater metric usage (Industrial Engineering Staff and the Engineering Support Branch) because of the increasing metric usage outside of the Postal Service and because of time and cost savings. The Machines Control Branch respondent expects that degrees centigrade and meters will be used in measurements instead of degrees Fahrenheit and customary units of length by 1980 because of the increasing domestic use of metric. All three of these groups report that these changes will cause a less than 1 percent increase in operating costs.

Thirteen of the 21 respondents anticipate problems if metrication is merely evolutionary in nature (Assumption I). The most common anticipated problems are increasing difficulties related to dual dimensioning, international cooperation, conversion, and interfacing. Only the Mechanization Design Branch respondent believes that no intensified problems are anticipated if metrication is merely evolutionary in nature.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). Under this assumption, five Postal Service respondents anticipate increased costs during the transition period, no respondents anticipate savings, and 16 respondents anticipate no cost impacts.

Two respondents representing the following subdivisions expect their annual costs to increase less than 1 percent during the transition period:

a. Office of Technical and Advanced Planning due to temporary extra costs in weighing and sizing operations, and
b. Engineering Support Branch—a cost increase of $3,250 annually for drafting and specifications changes (heaviest cost impacts would be in first four years).

The Program Management respondent in the Bureau of Facilities believes that costs during the transition period would increase by 1 to 5 percent or $76,000 annually due to increased costs of $6,000 for training activities, $40,000 for conversion activities, and $30,000 for interfacing activities. The Letter Mail Equipment Branch respondent expects cost increases of 5 to 10 percent due to an increase in developmental costs of $250,000 annually. Finally, the Building Design Division respondent expects an annual cost increase of about $2,250,000 (10 percent or more increase) during the transition period because of cost increases for architectural engineering and design activities (actually these costs would be spread over 15 years, but the cost figure is prorated on a 10-year basis for comparability).

It would be necessary to replace many of the postal scales (those over a certain age) and modify other scales. It would probably be cheaper to replace the small postal scales than to modify them. The total cost of replacement and conversion would be about $11,836,000 and would take place over a period of about 5 years. A breakdown of these costs appears at the end of this chapter.

During the post-transition period under Assumption II, three respondents expect savings, one respondent expects cost increases, and 17 expect no cost impacts.

Three respondents representing the following subdivisions expect an annual savings of under 1 percent during the post-transition period under Assumption II:

a. Office of Technical and Advanced Planning—a slight savings in the weighing and sizing operations.
b. Engineering Support Branch—an annual savings of about $500.
c. Program Management in the Bureau of Facilities

The Letter Mail Equipment Branch respondent expects a cost increase in the post-transition period of 5 to 10 percent due to an increase in development costs of $250,000 per year.

All but three of the respondents (Buildings Branch, and Regional Management in the Bureau of Operations; and Building Design Division in the Bureau of Facilities) say that there would be long-term advantages to metrication under Assumption II. The most frequently mentioned advantages are operational improvement, better promotion of U.S. standards internationally, and improved international communication. Four respondents (Industrial Engineering Staff, and Office of Contract Programs in the Bureau of Research and Engineering; Construction and Coordination Division, and Program Management in the Bureau of Facilities) mention cost decrease as a long range advantage. The Office of Technical and Advanced Planning respondent believes that the metric system would be easier for the mailing public to comprehend and apply. "The base ten system is easier to read and compute, it prevents some errors, and is easier to visualize." Others mention that it is easier to do engineering design calculations in metric.

Only two respondents believe that there would be any long-range disadvantages to metrication under Assumption II. The Letter Mail Equipment Branch respondent says that cost increases and operational impairment would result; the Mechanization Design Branch respondent believes that there would be a cost increase.

Ten[3] of the 21 respondents say that advantages of metrication under Assumption II would outweigh disadvantages. Five[4] of the 21 respondents believe that advantages would not outweigh disadvantages. One of these five, the Letter Mail Equipment Branch respondent, maintains that metrication in measurement units only is a "halfway measure" and that advantages would not outweigh the disadvantages. Three respondents (Standards Division of the Industrial Engineering Directorate and Specifications in the Bureau of Research, and Engineering and Building Design Division in the Bureau of Facilities) are uncertain whether advantages would outweigh disadvantages and three subdivisions provide no information.

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[3] These are: Office of Technical and Advanced Planning (2), Machines Control Branch in the Mechanization Engineering Division, Office of Contract Programs, and Engineering Support Branch in the Bureau of Research and Engineering; Utilization and Requirements Division in Bureau of Operations; Program Management in Bureau of Facilities; Law Enforcement Science and Technology in Bureau of Chief Postal Inspector; and Engineering and Instruction Division in the Postal Service Management Institute (2).

[4] Industrial Engineering Staff, Mechanization Design Branch in the Mechanization Engineering Division, and Letter Mail Equipment Branch in Bureau of Research and Engineering; Utility Design Division, and Construction and Coordination Division in the Bureau of Facilities.

If there were a planned national effort to adopt metric measurement units, the primary impact would be in the areas of operations, maintenance and equipment (altering the charts on postal weighing scales, for example), and retraining.

The respondent from the Building Design Division of the Bureau of Facilities believes that there would be serious problems of getting the construction industry to accept the metric system. There would also be legal problems involved in metrication under Assumption II. The legal problems would be concerned with revising specifications, changing all laws relating to weight and measurement of mail according to classification structure, and altering the weight, rate, and cube requirements.

In order to implement the changeover, the subdivisions would have to teach courses, change all scale and measuring devices, revise published material, provide on-the-job training, make minor changes in drafting tools, cooperate with the construction industry, dual dimension drawings, and change and reissue all standard drawings.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). All 21 of the respondents anticipate cost impacts during the transition under Assumption III identical to those given under Assumption II. The costs to modify and replace the postal scales under this assumption are identical to those given under the prior assumption. During the *post-transition* period, all respondents give identical responses concerning cost impacts as they give under Assumption II, except the Letter Mail Equipment Branch respondent. This respondent strongly believes that metrication only in units would result in more problems than benefits. However, if there were metrication in standards as well as units, there would be a cost savings in developmental activities of $125,000 per year or 1 to 5 percent during the post-transition period (in contrast to a cost *increase* of $250,000 per year or 5 to 10 percent during the post-transition under Assumption II).

All but one of the respondents specify the same advantages and disadvantages under Assumption III as they do under Assumption II. The Letter Mail Equipment Branch respondent believes that there would be long range disadvantages under Assumption II due to cost increases and operational impairments; under Assumption III, however, there would be some cost decreases and operational improvements. If there were metrication in engineering standards, there would be eventual worldwide standards agreements without all the problems of conversion between two systems.

Eleven of the 21 respondents believe that advantages would outweigh the disadvantages under Assumption III. Four respondents say that advantages would not outweigh disadvantages; three respondents are uncertain; and three subdivisions provide no information. All respondents except one provide the same answers under Assumption III as they do under Assumption II. The Letter Mail Equipment Branch respondent says that advantages would outweigh disadvantages under Assumption III, but not under Assumption II.

If there were a planned national effort to adopt metric engineering standards as well as metric measurement units, the respondents cite legal or other problems, including retraining of personnel, revision of specifications, and other operational problems. The Office of Technical and Advanced Planning respondent mentions the lack of industry-wide standards. The Building Design Division respondent in the Bureau of Facilities sees a problem in getting the construction industry to agree on new standards. For most of the responding subdivisions, the problems of metrication under Assumption III would be identical to those under Assumption II.

In order to implement the changeover, the respondents believe that, in addition to the tasks described under Assumption II, they would have to convert engineering specifications appearing in plans, contracts, and reports, revise manuals containing standards, obtain new testing equipment, and rewrite new standards and equipment specifications.

Changes in postal mail rates would have to be made if it were desirable to have whole (and not partial) units. Congress has established the postal rates based on the avoirdupois ounce which does not come out to any even metric units (28.350 grams). As a result, the new U.S. Postal Service would have to establish a new base for postal rates based on the metric system, and such a base would have to be established before the Service could modify or replace its postal scales.

6. Conclusion. Fourteen[5] of the 21 respondents favor a nationally coordinated program to increase the use of metric measurement units. Only two respondents, one each from the Letter Mail Equipment Branch and the Utility Design Division, do not favor a national program. Three respondents (one each from Industrial Engineering Staff, the Mechanization Design Branch, and Program Management) are uncertain whether there should be a national program. Agency subdivisions currently doing business in both metric and English measures prefer a complete conversion to the metric system.

The following types of concerted action are suggested: congressional action, retraining of personnel, public education, agreements within industry, publicizing the metric system's advantages and mandatory Government procurement in industry. Legislation making metric usage mandatory is specifically mentioned by six[6] of the respondents.

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[5] These are: Office of Technical and Advanced Planning (2), Industrial Engineering Staff, Machines Control Branch, Specifications, Technical Proposal Evaluation Staff, Office of Contract Programs, and Engineering Support Branch in the Bureau of Research and Engineering; Utilization and Requirements Division in the Bureau of Operations; the Building Design Division, and Construction and Coordination Division in the Bureau of Facilities; Law Enforcement Science and Technology in the Bureau of Chief Postal Inspector; and Engineering Instruction Division in Postal Service Management Institute (2).

Fourteen of the 21 respondents favor a nationally coordinated program to increase use of metric in engineering standards as well as in measurement units. The 14 respondents cited here are identical to the 14 respondents favoring conversion in units only (referred to above) except for the following two respondents. The Letter Mail Equipment Branch respondent wants metrication in both units and engineering standards, but does not want metrication in units only. On the other hand, the Law Enforcement Science and Technology respondent wants metrication in units only, but does not want to go to metric engineering standards.

The Letter Mail Equipment Branch respondent believes that metric engineering standards would have to be phased in under a program legislated by Congress. Several respondents suggest that the Government work through industry-wide committees in developing new standards.

Nine of the 21 respondents regard a 10-year period for transition to metric measurement units as satisfactory.[7] Six do not know whether a longer or shorter period than 10 years would be preferable.

Three subdivisions recommend a shorter transition period and one would like a longer period.[8] The Mechanization Design Branch respondent suggests a 3-year period since a shorter period would get industry and government together at an earlier date. The Office of Contract Programs respondent believes that a 5-year period would reduce procrastination. The Engineering Support Branch respondent prefers 5 years since the conversion of drawings, etc. could be accomplished in that time period. Finally, the Building Design Division respondent suggests 25 years as a transition period since in that period a whole new generation of people could be educated in the metric system.

Impacts of Metrication on Mail Delivery Operations

Present Metric Usage. Metric measures are employed in less than one-quarter of all mail delivery operations. There is a trend toward increasing use of the metric system in mail delivery, especially in other countries.

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[6] These are: Office of Technical and Advanced Planning, Industrial Engineering Staff, and Office of Contract Programs in the Bureau of Research and Engineering; Utilization and Requirements Division in the Bureau of Operations; Construction and Coordination Division in Bureau of Facilities; and Engineering and Instruction Division in the Postal Service Management Institute.

[7] These are: Office of Technical and Advanced Planning (2), Industrial Engineering Staff, and Technical Proposal Evaluation Staff in Bureau of Research and Engineering; Utilization and Requirements Division of the Bureau of Operations; Utility Design Division, and Construction and Coordination Division of Bureau of Facilities, and Engineering and Instruction Division of the Postal Service Management Institute (2).

[8] The optimum period for converting to metric engineering standards is identical to that for units in the case of all respondents except the Letter Mail Equipment Branch. In this case, the respondent favors a 10-year transition for engineering standards but is uncertain with regard to measurement units only.

Countries participating in the development of international mail standards are helping to increase worldwide metric usage.

Thus far, the impact of the increasing worldwide and domestic use of the metric system on mail delivery has been *negligible.*[9]

Future Impacts of Metrication. If there is no concerted action by the Federal Government toward increasing the use of the metric system, the U.S. Postal Service will probably have dual dimensions for some manufacturing drawings and will probably have to retrain some Postal Service personnel in the metric system. All in all, though, there will be *negligible* impact on the ability of the Postal Service to perform its mission.

A nationally planned program with a 10-year transition period would require training programs to acquaint Postal Service personnel with the metric system. Dual measurements would be required for some time on such equipment as parcel post scales, where weight measurements are related to postage charges. If the transition period were longer, the Postal Service could increase the use of the metric system in Postal Service work more gradually and reduce the possibility of unnecessary costs which could arise over a shorter time frame.

It is the opinion of Postal officials that a nationally planned metrication program would have a *trivial* impact on the postal system. Once the U.S. Postal Service has adopted a new system and has trained its personnel, there would be little effect on the Postal Service's ability to deal with its area of national responsibility irrespective of how metrication came about.

What Action Should Be Taken? Where the metric system interfaces with the mission of the U.S. Postal Service, the Postal Service would evaluate the situation and take whatever action would be necessary in its own best interests.

Costs: Metrication of Postal Scales

The following chart on the costs of replacement and adaptation of postal scales is based on information supplied by the U.S. Postal Service and various scale companies. These metrication unit costs are approximate averages only. For example, in the case of beam scales, the first item on the chart, the metrication cost per unit, is an estimate of the average unit cost, but the actual unit cost to adapt any particular beam scale may be above or below this figure.

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[9] See "Classification of Intensities of Impact" scale on p. 79.

Type [1]	Number in use	Type of metrication adaptation/ replacement	Metrication cost/unit	Total cost for each type (column 2 times column 4)
Beam scales which have capacities between 100–6,250 lbs.	4,720	Adaptation	300.00	$1,416,000
Drum type computing and automatic meter scales.	3,320	Adaptation	150.00	498,000
Fan type computing scales	36,000	Adaptation	75.00	2,700,000
10 ton capacity vehicle scales	50	Adaptation	500.00	25,000
16 oz beam scales	205,000	Replacement	35.00	7,175,000
500 lb. parcel post dial scales	220	Adaptation	100.00	22,000
Totals	249,310			11,836,000

[1] For convenience, the number of scale categories, as received from the U.S. Postal Service, has been reduced from 16 to 6 by combining categories of similar types of scales.

It is estimated that it would take at least 5 years to complete scale adaptation or replacement.

Many of the scales (perhaps 25 percent of the total number of scales) now in use will have to be replaced because of obsolescence. Since the replacement scales could be metric-based, much of the costs of metrication would in actuality be normal replacement costs.

U.S. TARIFF COMMISSION

Liaison Representative:

A. F. Parks, Chief, Technical Service

Respondent — Internal Operations:

1. Technical Service

Respondents — International Trade Area of National Responsibility:

1. Chief, Technical Service
2. Commodity Industry Analyst

1. Mission of the Tariff Commission. The United States Tariff Commission was created by Act of Congress approved September 8, 1916. The Commission's powers and duties are provided for largely by the Tariff Act of 1930, as amended; the Trade Expansion Act of 1962; the Antidumping Act of 1921, as amended; the Agricultural Adjustment Act, as amended; and the Automotive Products Trade Act of 1965.

These statutes require the Commission to investigate and report upon tariff and foreign trade matters. The Commission makes such investigations and reports at the request of the President, either branch of the Congress, the House Committee on Ways and Means, the Senate Committee on Finance or upon its own initiative. Investigations into the effects on domestic industries, firms, or groups of workers, of increased imports resulting from trade agreements concessions may be requested by the interested parties. In addition to the variety of public investigations which generally include public hearings and usually relate to specific commodities, the Commission also undertakes research and special studies relating to significant aspects of the overall commercial policy and international trade of the United States.

The agency is frequently called upon to advise the Congress as to the probable effects of enactment of proposed trade legislation, and to advise the President in connection with forthcoming international trade negotiations.

The Commission, in the fulfillment of its investigative and advisory role regarding the international trade of the United States, is a primary user of trade data with respect to imports, domestic production, and exports. Inasmuch as the United States has historically made little use of the metric system's units of measurement for the goods traded in its markets, virtually all the trade data has been and is collected, published, and analyzed on the basis of non-metric units.

Staff specialists of the Commission participate on a continuing basis in the interagency statistical programs for improving and promoting greater comparability of the data collected on domestic production, exports, and imports. From the Commission's point of view, therefore, the substitution of metric units for non-metric units as the valid units for the measurement of U.S. trade would necessarily require timely changes in the affected parts of the relevant statistical schedules. Moreover, the process of changeover would necessarily involve the Commission's staff in the preparation of conversion tables to permit an orderly transition through the maintenance of continuity of data regarding U.S. trade trends.

Changes in the product classes for collecting data with respect to domestic production and exports can be accomplished administratively without legislation. A somewhat different situation exists with respect to import data. Import data is collected within the framework of the Tariff Schedules of the United States (TSUS), the basic law prescribing the rates of duty on imported merchandise. For a number of import classes in the TSUS the tariff descriptions and/or the rates of duty are expressed in non-metric units of quantity such as pounds, bushels, dozens, gallons, board feet, inches, feet and yards. To effect changes in such units, legislation would be required. The bulk of the trade, however, is accounted for by articles which are free of duty or dutiable at ad valorem rates. The statistical data collected for these tariff classes are controlled administratively by an interagency committee chaired by the Tariff Commission representative. Hence, any changes to be made in the reported units of quantity for such tariff classes would not require legislation.

The development and widespread acceptance for products in U.S. trade of metric engineering standards, as well as metric measurement units, undoubtedly would have a material influence on the volume of import trade, especially if such standards also had international acceptance.

2. Present Metric Usage. As previously indicated, there is little present usage of metric units in relation to products moving in United States trade. Therefore, the statistical classes used for the collection of domestic production, export, and import data involve minimal uses of the metric system.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Under this assumption, no changes toward increased metric usage will be made except by voluntary industry adoption or unless legislation by the U.S. Congress requires increased metric usage. If there is no further usage of metric units in U.S. trade there will continue to be increasing problems involving international cooperation, conversion, and legal difficulties because of the increasing worldwide metric usage.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). During the transition period, the costs of operation of the Tariff Commission would increase from 5 to 10 percent under Assumption II. The average annual cost increase would total $375,000 due to $50,000 for investigations, $100,000 for research, $150,000 for statistical analyses, and $75,000 for statistical reports. During the post-transition period there would still be added costs resulting from metrication of about $187,000 per year (or 1 to 5 percent), due to $50,000 for investigations, $50,000 for research, $75,000 for statistical analyses, and $12,000 for statistical reports.

Following the transition period, it is believed that there would be operational improvement in the Commission resulting from conversion to the use of metric measurement units. Metrication would also help promote U.S. standards internationally and improve international communication. The statistical reporting of imports would be vastly improved; analysis of worldwide trade facilitated; and valuation of merchandise made easier. However, all these improvements would be counterbalanced to some extent by the increased operating costs which conversion would bring to the Tariff Commission even after the transition. The Commission feels, though, that the advantages of conversion would outweigh the disadvantages.

In order to implement the changeover, the Commission would assist in the preparation of Congressional legislation to convert units of measurement (pounds, inches, gallons) in the Tariff Schedules, particularly with respect to product definitions and tariff provisions based on weight, length, and capacity. The Commission would also be called upon to assist in renegotiation of trade agreements. Finally, the Commission would initiate action to provide new statistical enumerations for imports, and maintain a dual system of trade statistics for several years.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Measurement Units (Assumption III). Under this assumption, the cost impacts on the Tariff Commission would be greater during the transition than they would be during the transition under the prior assumption. Costs would increase by $575,000 or over 10 percent during the transition due to $250,000 for investigations, $100,000 for research, $150,000 for statistical analyses, and $75,000 for statistical reports. During the post-transition period average annual added costs from metrication would total $166,000 (or 1 to 5 percent) due to $75,000 for investigations, $40,000 for research, $50,000 for statistical analyses, and $1,000 for statistical reports.

The long-term advantages and disadvantages under this assumption are nearly identical to those described under the prior assumption. An additional advantage from metrication in engineering standards is that there would be greater comparability of foreign and domestic articles of the same design.

If metrication in engineering standards were proposed for adoption, or were adopted by the United States, the Commission might be called upon to investigate and evaluate the actual or potential competitive effects of imports caused by metrication, in addition to those tasks described under the previous assumption.

6. Conclusion. The work of the Tariff Commission would be facilitated by the use of uniform measurement units in all phases of international trade. It is evident that the only system which could gain international acceptance in the foreseeable future is the metric system. It is believed that insofar as the work of the Commission is concerned, a complete conversion by a specific date would be preferable. The date selected should be far enough in the future (say about 5 years) to permit an orderly transfer. During that period, the use of dual systems should be encouraged – first, by voluntary compliance, and finally by law or regulation.

Impacts of Metrication on International Trade

Present Metric Usage. The metric system is used in a very small portion of all work activities of international trade over which the Tariff Commission has cognizance. There is no apparent trend toward further metric usage. Thus far, the impact of the increasing worldwide and domestic metric usage has had *trivial*[1] impact on international trade over which the Commission has responsibility. Errors in statistics are frequently encountered from mistakes in conversions.

Future Impacts of Metrication. Assuming *no* concerted national action to increase metric usage, there will be little or no increase in metric usage in the areas over which the Tariff Commission has responsibility. There will be an increase in errors due to conversions, however, as a result of the increasing worldwide metric usage.

If there were a concerted national effort to increase metric usage in the United States, it is likely that both imports and exports would be facilitated. However, the effects on the flow of international trade cannot be predicted at this time. It is not known, for example, whether metrication would have a favorable impact or not on the balance of payments problem.

The impact of a planned national effort to increase metric usage would have *negligible* impact on the ability of the Tariff Commission to perform its mission, assuming that it would have an adequate staff.

What Action Should Be Taken? Since the Tariff Commission takes no position on the policy aspects of proposed legislation, it has no comments on whether the United States should adopt the metric system.

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[1] See "Classification of Intensities of Impact" scale on p. 79

VETERANS ADMINISTRATION (VA)

Liaison Representative:

Pierre S. Palmer, Member, Administrator's Advisory Council

Respondents — Internal Operations:

1. Director of Architecture and Engineering, Office of Construction
2. Executive Director for Administration, Department of Medicine and Surgery
3. Staff Assistant to Assistant Chief Medical Director for Professional Services, Department of Medicine and Surgery

Respondents — Health Area of National Responsibility:

1. Member, Administrator's Advisory Council
2. Executive Director for Administration, Department of Medicine and Surgery
3. Director of Architecture and Engineering, Office of Construction
4. Staff Assistant to Assistant Chief Medical Director for Professional Services
5. Office of Executive Director for Administration
6. Catalog Section, Personal Property Management Division

1. Mission of the Veterans Administration. The Veterans Administration (VA) administers laws authorizing benefits for former members of the armed forces and for the dependents and other beneficiaries of deceased former members of such forces. These benefits fall into the following major program areas: compensation and pensions, readjustment benefits, insurance, health services, and burial allowances. Of these program areas, the only one significantly affected by metrication would be the health services program, including the construction of health facilities.

2. Extent of Present Metric Usage. At the present time metric measurement units are used to some extent for patient measurements; dosage and proportions of pharmaceuticals; diet prescriptions and food composition; cataloging, procurement and accounting of drugs, medical supplies and equipment; and some screw threads and bolts on foreign produced medical equipment. Metric engineering standards are used in cataloging, procurement, and accounting when industry and national standards are based on the metric system.

The principal advantages of the present usage of the metric system are in international cooperation in the health field and the widespread usage of the metric system in scientific activities. When an industry such as the pharmaceutical industry uses the metric system for its products it improves the operation of the VA to do the same.

The disadvantages associated with the present usage of the metric system are lack of familiarity of VA staff with it, increased cost of maintaining duplicate tools, difficulty of obtaining metric replacement parts, and the general preferences of most industries with which VA deals for the customary units of measure. To the extent both the metric and customary systems are used, confusion is possible.

At the present time the disadvantages limit the use of the metric system to those areas where industry or scientific practice make it necessary to use it. There is no trend at present toward wider use of the metric system in the health field.

3. Anticipated Changes if There is No National Plan for Metrication. The VA does not plan to unilaterally expand its use of the metric system if there is no national plan for adopting the metric system. Any increase in VA's use of the metric system would be in response to its adoption by industry supplying the health field or increased usage by educational institutions such as medical schools. The VA is thus unable to predict what effect such changes might have in terms of its internal cost. The VA sees no legal or other problems in adapting to these changes if they are in response to adoption of the metric system by industries or health educators. The principal advantage would be standardization with international usage in the health field.

If elements of the health system adopted the metric system there would be serious problems for VA if it did not follow suit. VA would be faced with increased training requirements, dual dimensioning, conversion and interfacing requirements, and a waste of resources. On the other hand, for VA to adopt the metric system for its health service independently of similar action by the health field in general would create these same problems. An unplanned, piecemeal approach to metrication is likely to create more problems than advantages. A piecemeal approach is certainly far less desirable than a national approach to a general changeover from the customary to the metric system.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units and Metric-Based Engineering Standards. It seems likely that during the transition the cost of the conversion may well exceed any savings which would result from use of the metric system. During the post-transition period when there are no longer conversion costs, the VA expects that the new system would either have no impact on its internal costs or that there might be some savings.

The Office of Construction is the only VA respondent anticipating any direct cost impact. In converting to metric measurement units only, there would be an added cost of about $100,000 per year during the transition period. After the transition, there would be a savings of about $40,000 per year. However, if there is a conversion to metric standards as well as measurement units, there would be savings during both transition and post-transition periods ($20,000 per year during the transition and $240,000 per year after the transition).

In the construction of health facilities, the principal activities affected by the adoption of metric measurement units and metric engineering standards are dimensioning of architectural drawings and engineering calculations. For health services operations the principal effects would be in the procurement, cataloging, inventory control, and usage of all types of supplies and equipment and in the recording of patient data.

In the health facilities construction activities, the adoption of metric measurements without adopting metric engineering standards would be of little value. In fact, it would create the problem of converting from customary units to metric measurements. However, the adoption of both metric measurement units and metric engineering standards should result in a savings in VA's internal operating cost because of the greater ease of dimensioning and calculating in the metric system.

For health services activities other than construction, VA believes there would be operational improvements and possibly cost decreases from the adoption of the metric measurement units alone but these might be somewhat less than achieved by adopting both metric measurement units and engineering standards.

In both health facilities construction and health services operations there would be advantages in the improvement of international communication and in the promotion of U.S. standards. The VA believes that the advantages of adopting the metric measurement units and engineering standards would outweigh any disadvantages and would be worth the conversion cost as far as VA's internal operations in the health area are concerned.

To effect the changeover, the VA would need to train its personnel in the use of the metric units; obtain new text and reference materials; purchase equipment and instruments with metric calibration; and revise catalogs, records, and specifications.

The VA knows of no legal problems that would result from a transition to the metric system. The greatest problem which VA would have in the health services area would be the education and training of its staff. There would also be the problem of obtaining equipment using the metric system during the transition period and the repair and maintenance of equipment based on a dual system of measurement and engineering standards until all equipment based on customary standards has been replaced.

A 10-year transition period seems a reasonable one from the point of view of the VA but it would create the problem that some of its equipment has a longer than 10-year useful life. With a 10-year transition period, the VA would either have to replace some equipment before it has served its useful life or continue a dual system for at least an additional 10 years until all equipment had been replaced under its normal replacement program.

5. Conclusion. The impact of adoption of the metric system upon the VA health services program would be similar to that for the entire health field. It is VA's judgment that the U.S. should adopt a national program for converting to metric measurement units and metric engineering standards over a transition period of approximately 10 years.

Overall for the VA the intensity of the impact of metrication would fall in the classification *trivial.*[1] The effects would vary from activity to activity and except in the health services area would be *negligible*. In health services the impact on the several components would range from *negligible* to *moderate*. The greatest impact might be in the construction of health facilities but even there the VA feels the conversion would be worthwhile if both the metric measurement units and the metric engineering standards are adopted.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

Impacts of Metrication on Health Services

Present Metric Usage. At present the metric system is used in the drug industry and to some extent by hospitals in recording patient data. It does not appear that there is a trend toward increased use of the metric system because to go beyond the present limited use of metric measurement would involve the more costly adoption of metric engineering standards.

Future Impacts of Metrication. If there is increasing use of the metric system without a coordinated program for its national adoption, the result will be two measurement systems with the costs and inefficiencies of conversion from one to the other and the necessity of duplicate tools for equipment repair and maintenance. Health personnel will have to be trained in the use of both systems and there will be confusion in data gathering and reporting. Such results will be undesirable and will impair to a degree VA's ability to perform its health mission in an efficient and effective manner.

Major advantages to the nation's health field of a nationally coordinated program to increase the use of the metric system would be facilitating measurement and calculation, increasing international communication and cooperation and avoiding the present problems of incompatible equipment because of the use of two different systems. The principal impacts of the change would be in the necessity of training health personnel in the use of the metric system and the conversion or replacement during the transition period of instruments and equipment. While a 20-year transition period would ease the equipment conversion problem by normal attrition, a more optimum period would be 10 years in order to minimize the time that the health field would operate using two systems. The intensity of the impact on the health field would vary by component elements with the average impact classified as *trivial*.

What Action Should Be Taken? The impact of adoption of the metric system upon the VA health services program would be similar to that for the entire health field. It is VA's judgement that the U.S. should adopt a national program for converting to metric measurement units and metric engineering standards over a transition period of approximately 10 years.

COUNCIL OF ECONOMIC ADVISORS

Liaison Representative:

Irene Lurie, Staff Economist

Respondent — Internal Operations:

1. Member, Council of Economic Advisors

The Council of Economic Advisors analyzes the national economy and its various segments; advises the President on economic developments; appraises the economic programs and policies of the Federal Government; recommends to the President policies for economic growth and stability; and assists in the preparation of the economic reports of the President to the Congress.

Because the Council of Economic Advisors' activities are not significantly affected by the system of weights and measures used, the effect of metrication on the Council's operations would be negligible. Thus, there would be no difficulty in adjusting to a nationally planned program of conversion to metric measurement units and/or metric engineering standards, and there would be no costs, savings, or long-term advantages anticipated for the Council.

For these reasons and because the Council's area of responsibility is so broad that much study would be required before recommendations could be made, the Council cannot say whether or not it would advocate a planned national program of metrication.

The Council notes a number of points that should be considered by the U.S. Metric Study Group. They are as follows:

1. The appropriate role of government is to coordinate conversion if and when industry reaches a consensus.
2. But the government should help determine the rate of discount of future benefits from conversion because industry may use a higher rate than is used by society as a whole.
3. The government also has a role to play in making the decision whether to convert, where those who would benefit from conversion are less vocal than those groups likely to incur larger costs.
4. In evaluating benefits, the most weight should probably be given to the resulting increase in foreign trade. The volume of trade, not the balance of payments, should be used as a measure of the impact.
5. The relative unimportance of trade to our country makes the decisions of other countries to convert less relevant to our decision.
6. In evaluating costs, emphasis should be placed on the resources required for new machinery, larger inventories, new

books, signs, etc. Confusion, reluctance to deviate from tradition, and time spent learning the system should not be overemphasized.

7. In the short run, costs of conversion will undoubtedly appear large relative to the benefits of increased trade. But since benefits accrue indefinitely into the future, the decision ultimately depends on how future benefits are discounted.

OFFICE OF EMERGENCY PREPAREDNESS (OEP)

Liaison Representative:

John F. Allums, Intelligence Officer, National Resource Analysis Center

Respondents — Internal Operations:

1. Materials Policy Division, National Resource Analysis Center
2. Economic Stabilization Division, National Resource Analysis Center
3. Systems Evaluation Division, National Resource Analysis Center
4. Resources Evaluation Division, National Resources Analysis Center
5. Mathematics and Computation Laboratory, National Resources Analysis Center
6. Government Preparedness Office
7. Field Operations Office

Respondent — Transportation Area of National Responsibility:

1. Transportation Office

1. Mission of Office of Emergency Preparedness. OEP advises and assists the President in the nonmilitary defense and emergency preparedness programs of the United States. These programs include policy development, planning, and other activities relating to civil defense, resource mobilization, stockpiling, emergency stabilization of the civilian economy, continuity of government, and rehabilitation of the United States after nuclear attack. OEP's mission also includes investigation of imports that threaten to impair national security and activities related to the authorization of Federal assistance to state and local governments in coping with major disasters.

2. Extent of Present Metric Usage. OEP's activities entail only limited use of the metric system. This use is concerned mainly with materials specifications for the stockpiles, the handling of data from sources that use metric units in their records, and some aspects of emergency planning in the transportation field — particularly in maritime shipping. There are no discernible trends in OEP's use of the metric system.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Under this assumption OEP will have to make changes to cope with the increased use of metric units in connection with weights and dimensions of materials for the stockpiles. OEP is not able to forecast whether the advantages of such changes will outweigh disadvantages. The total impact of the changes on OEP's work, however, will be trivial. There will be no substantial problems connected with the change, and related costs will be minimal. Such costs as occur will derive mainly from the need to conform to industry changes and the need for revision of documents.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). The impact on OEP activities would be somewhat greater under this assumption than under the preceding assumption, but the impact would still be trivial. Formats for stockpile reports would have to be revised, and certain other minor adjustments made, but there would be no substantial problems involved.

OEP's increased annual costs under this assumption would be slight. Only the Materials Policy Division anticipates increased costs, which it estimates to be about $500 per year during the transition period. OEP is not able to forecast whether the advantages connected with these changes would outweigh the disadvantages. However, over the long-term, international communications would be facilitated. Those respondents having any opinion on the matter state that the 10-year transition period would be satisfactory.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Metric Measurement Units (Assumption III). Under this assumption the impact on OEP would be somewhat greater than under Assumption II, but still trivial. As is the case with the prior assumption, only the Materials Policy Division estimates any increased cost ($500 annual added costs during the transition period). There would be no substantial problems involved. The most important change required under this assumption is that formats for stockpile reports would have to be revised and new specifications and instructions for stockpiled materials issued. OEP is not able to forecast whether the advantages would outweigh disadvantages, even though international communications probably would be facilitated. A 10-year transition period is considered satisfactory.

6. Conclusion. OEP has no strong opinion on whether there should be metrication in the United States, but favors moderate, feasible action to this end.

Impacts on OEP's Transportation Area of Responsibility

Present Usage of the Metric System. The metric system is used in less than one-quarter of OEP's transportation work. There is a trend, however, toward greater metric usage. As international trade and travel increase in importance, the use of a more standardized vocabulary receives more attention. For example, OEP's participation in NATO planning and American, British, and Canadian (ABC) standardization groups has had an influence on the use of terms in OEP.

Thus far, the impact on OEP's transportation work of increasing worldwide and domestic metric usage has been *trivial.*[1] For example, some metric system terminology is used by OEP, particularly in maritime shipping (e.g., descriptions of ports and harbors, sizes of containers, and measurement of cargo weights in metric tons).

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[1] See "Classification of Intensities of Impact" scale on p. 79.

Future Impacts of Metrication. If there is no action by the Federal Government, increasing metric usage will have very little impact on transportation.

Assuming a nationally planned program to increase the use of the metric system, OEP would be able to perform its mission more effectively with regard to transportation. There would be better coordination and understanding between countries. Cost figures cannot be estimated with regard to the benefits of metrication, but impact of such a program on transportation would be *moderate*.

What Action Should Be Taken? OEP recommends that the metric system be adopted as early as consistent with general social and economic conditions.

OFFICE OF SCIENCE AND TECHNOLOGY (OST)

Liaison Representative:

S. William Gouse, Jr., Technical Assistant for Housing and Transportation

Respondent — Internal Operations:

1. Technical Assistant for Housing and Transportation

Respondents — Science and Technology Area of National Responsibility:

1. Technical Assistant for Housing and Transportation
2. Technical Assistant for Medical Area
3. Technical Assistant for Earth Sciences
4. Technical Assistant for Space and Civil Aviation
5. Technical Assistant for Information Systems
6. Technical Assistant for Water Resources
7. Technical Assistant for Energy Policy
8. Technical Assistant for Agriculture and Applied Biology
9. Technical Assistant for Environment
10. Technical Assistant for National Security
11. Technical Assistant for Military Technology
12. Technical Assistant for Academic Science
13. Technical Assistant for Education
14. Technical Assistant for International Science

1. Mission of the Office of Science and Technology. OST, which is in the Executive Office of the President, evaluates major policies, plans, and programs of science and technology within the various agencies of the Federal Government. In this evaluation, OST gives appropriate emphasis to the relationship of science and technology to national security and foreign policy. OST also seeks close relations with the Nation's scientists and engineers in order to further their participation in strengthening U.S. science and technology.

2. Present Metric Usage. OST does not work with metric measurement units or metric engineering standards, but OST often examines data and reports which, in many cases, are in metric units.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). OST anticipates no changes toward increased metric usage if there is no national plan for metrication.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). Under this assumption, there would not be any significant or identifiable cost impacts upon OST either during or after a transition period. In the long run, metrication would be advantageous to OST. Advantages would include cost decreases, operational improvement, better promotion of U.S. standards internationally, and improved worldwide communication through international uniformity. No significant problems are foreseen for OST during a transition period.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). The impacts on OST from metrication under Assumption III are identical to those described under the prior assumption.

6. Conclusion. OST favors concerted national action, including federal incentives, to bring about changes toward metrication in measurement units and engineering standards.

Impacts of Metrication on U.S. Science and Technology

Present Metric Usage. The metric system is used in over three-quarters of all work activites in the medical and earth sciences. No discernable trend toward further use of the metric system in medical sciences is visible. However, there is a trend toward its increasing use in the earth sciences. Increasing metric usage has had *trivial*[1] impact on the medical areas to the present. The impact on the earth sciences area has been *negligible* since the fields of geophysics, oceanography and meteorology have strong European roots and thus an early tradition of metric usage. The most notable exception of customary usage in the earth sciences is the nautical mile.

The metric system is used in one-quarter to three-quarters of all work activities in the following scientific and technical areas: academic science, military technology, and information systems. Actually, with regard to information systems, the devices and hardware used to handle and distribute information are becoming increasingly standardized, and metric usage is becoming increasingly common. There is no discernible trend toward greater metric usage in national security affairs or in space and civil aviation.

The impact of the increasing metric usage has been *negligible* on academic science, space and civil aviation affairs, and military technology. The impact on information systems and national security affairs has been *trivial*.

The metric system is used in less than one-fourth of all work activities within environmental sciences, applied biology (agriculture, fisheries, forestry), energy, and water resources. There appears to be no trend toward greater metric usage in these areas.

The impacts of increased metric usage on energy and water resources studies have been *negligible*. International trade in the energy industry consists mainly of fuels, for which the unit of measurement is not very important. Much oil field equipment used in other countries is made in customary standards by American companies. With regard to water resources, the only observable impact is the use of converted metric equivalent units in parenthesis in papers destined for purely international audiences.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

The impacts of increased metric usage on environmental studies and applied biology have been *trivial.*

Future Impacts of Metrication. Assuming *no* concerted national action to increase metric usage, there will probably be little or no impact from increasing worldwide and domestic metric usage on the following areas: medicine, earth sciences, academic science, space and civil aviation, national security, environment, and military technology. There will be increasing complications, however, in applied biology (which includes agriculture), water resources, energy, and information systems.

There will be increasing complications in import and export of food and fiber if there is no planned metrication. There may be reduced markets for American-made machinery because of noninterchangeable parts and the inconvenience in repairs. Water resources, a field which still uses "miner's inches" will find it increasingly painful to adjust to increasing metric usage. Confusion and increased costs are expected in the energy field. There will be a gradual adoption of metric usage in the information systems field in the U.S. even if there is no concerted action by the U.S. to increase metric usage.

If there were a *nationally planned program* to increase use of the metric system, there would be little impact on environmental and academic sciences. There would be problems during the transition for space sciences and civil aviation, national security, water resources, and applied biology, but no great effects after the transition. National security would not suffer, but the advantages of metrication would not be significant. With regard to water resources, the biggest problem would be the conversion of land records; thereafter, public acceptance of the metric system would be the problem. There would be difficulties inherent in a dual system and in the converison of manufactured agricultural equipment. Information systems and military technology would benefit from a planned program of metrication, because of the current trend toward universality of equipment.

Numerical indicators of the impact of metrication would include export figures (e.g., computer tapes) to metric countries, and the use of metric units *vis a vis* customary units in technical literature.

Adoption of the metric system would improve the effectiveness of the OST within the areas of military technology, information systems, earth sciences, national security, applied biology, and medicine. One advantage often cited is that a single system would eliminate the need for conversions. Also, the metric system is easier to work with than the customary system. Adoption of the metric system would accelerate development of universal standards.

Adoption of the metric system would impair the effectiveness in energy studies. It is not certain if metrication would improve or impair the effectiveness of OST in space sciences and civil aviation, academic science, and environmental studies.

The intensities of impact on the ability of OST to perform its mission with regard to academic science, space and civil aviation, water resources, earth sciences, and applied biology would be classified as *negligible.* Impacts with regard to environmental and national security affairs would be *trivial.* The impact on the OST's ability to perform its mission with respect to military technology would be *negligible* in some cases and *trivial* in others.

What Action Should Be Taken? Metrication is favored by the OST respondents for military technology, national security, environmental studies, applied biology, earth sciences, and academic science. OST's military technology specialist believes that the United States should press forward with all due haste in those areas where metrication is feasible. Even though he does not think that metrication would have any significant effect on national security, the assistant for national security affairs believes that the United States should move toward metrication since it is "inevitable." The assistant for agriculture and applied biology believes that metrication should be initiated in export markets and that a dual marking system should be initiated domestically.

Technical assistants for water resources, space sciences, and civil aviation are neutral with regard to whether action toward metrication should be taken.

Technical assistants for education and international science believe that metrication in the United States would be beneficial from their standpoint. Metrication would greatly benefit international technical cooperation.

The technical assistant for education believes that metrication would be both easy and advantageous from the standpoint of education. Both the metric and customary systems are taught now in schools; the metric system now dominates in science courses. Metrication would simplify arithmetic, delay introduction of fractions, and simplify much learning for children.

OFFICE OF TELECOMMUNICATIONS POLICY (OTP)

Liaison Representative:

William E. Plummer, Acting Director

Respondent — Internal Operations:

1. Acting Director

Respondents — Telecommunications Area of National Responsibility:

1. Acting Director
2. Staff Assistant

1. **Mission of the Office of Telecommunications Policy.** The OTP, formerly the Office of Telecommunications Management in the Office of Emergency Preparedness, became a separate Office within the Executive Office of the President on September 4, 1970. As the name indicates, OTP is concerned primarily with establishing telecommunications policy in the Federal Government. This activity requires continuous contact with all aspects of telecommunications, including: organization, administration, and management of telecommunications activities; complex electronic theories and concepts; studies, plans and programs concerning day-to-day operations; systems design; and research and development.

2. **Present Metric Usage.** Both metric measurement units and metric-based engineering standards are used in OTP's work. Many of the studies and plans which OTP must review, evaluate, and analyze include both metric and customary measurement units. For example, OTP uses computer-based information as an aid to management of the radio frequency spectrum; some of the information is metric and some is customary as is consistent with present usage in the U.S. OTP uses conversion tables when necessary.

Thousands of technical telecommunication standards use measurement units. These standards generally consist of a mix of metric and customary units. Most electrical/electronic parameters are in metric. Some electrical properties (e.g., cavity sizes and grid spacings) of components and equipment are in meters and some are in inches.

This dual system is often confusing. An antenna height may be cited in feet, but the length of its radiating elements may be cited in meters. Although meters are used in measuring wavelengths and the tuned elements of antennae, antennae heights are measured in feet. Antennae heights are usually associated with existing natural or man-made terrain and, as is customary in the United States, these are measured in feet or miles. Confusion is lessened by converting these terrain measurements to meters.

OTP cannot cite any advantage of one system over the other, but recognizes, however, that a single system – either metric or customary – would be better than a dual system since the need for conversion would be eliminated.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). Under this assumption, OTP plans no changes toward increased metric usage. However, due to the increasing metric usage outside of OTP, OTP personnel will have to be trained to a greater extent in metric usage.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption, OTP anticipates a cost increase of about $1,500 per year during the transition period in order to change coordination distances from miles to meters in computer storage. No cost impact is seen after the transition.

According to OTP, no noticeable long term advantages or disadvantages are anticipated. Eventually, standardization on either metric or the customary system should offer savings in time and money, but OTP cannot make such an estimate at this time. Since no problems are foreseen in converting to the metric system, no significant procedures for implementing the changeover are needed.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). The responses from OTP under this assumption are identical to those given under the prior assumption.

6. Conclusion. OTP favors concerted action in the United States to bring about changes toward metrication in measurement units and engineering standards. OTP recommends that the Government with the help of electronics equipment manufacturers and through existing industry standardization organizations establish an implementation schedule. Manufacturers could coordinate plans with their customers. OTP believes that it is impossible to adopt metric engineering units without adopting metric-based engineering standards in the field of electronics.

Impacts of Metrication on Telecommunications

Present Metric Usage. It is estimated that the metric system is used, to some extent, in between one-quarter and three-quarters of all communications activities associated with OTP. There is a trend toward increasing metric usage. Generally, within the telecommunications field, physical (dimensional) measurements and standards are in customary units. Physical dimensions having electrical effects (e.g., tuning elements) are most often stated in metric terms. Many of the energy measurements and standards are in both metric and customary terms, though metric terms predominate. Flow rate and velocity are also often found in both metric and customary terms. Temperature is given in Celsius and Kelvin more often than in Fahrenheit. Density, volume, weight, length, depth, width, area and distance are expressed more often in customary than in metric units.

Thus far, the impact of increasing metric usage on OTP's communications responsibilities has been *trivial.*[1] For the most part, conversion tables are not required for most of the evaluatory or analytical work done by OTP. They are required, however, to solve mathematical problems.

Future Impacts of Metrication. The major impact of a conversion to the metric system would be felt by U.S. equipment manufacturers. If a change to the metric system were made, the industry would find it necessary to change some of the physical dimensions of tooling and products. If this were done, there could be a large impact on user facilities. The Government, as a major user of telecommunications facilities and services, would feel the impact through added costs for the conversion of industry products and user facilities during the transition period.

To the present time, costs of telecommunications products and services have decreased as new ways to perform old functions have been developed. If this trend is maintained, the cost of conversion may not be an increase in cost, but rather, a slower rate of cost decline. OTP assumes that the U.S. communications common carriers would gradually convert to the metric system as equipment manufacturers and other suppliers convert.

OTP assumes that metrication may make foreign markets more receptive to U.S. electronic products than they are today. Many other factors, however, such as reciprocal trade agreements, import-export limitations, etc., affect international marketing. OTP cannot predict that changing to the metric system—a relatively small factor—would have significant impact on international trade. However, major improvements in electronic standards among nations, with particular emphasis on U.S. participation, would have strong foreign market implications whether the adopted units were metric or customary.

A 10-year transition period seems unrealistic, according to the OTP. Some of the technical standards which OTP uses, for example, are developed over a 10- to 15-year period. Much of the in-place facilities have depreciable life spans of 10 to 20 years and expenditures must be amortized. A 20-year transition period is recommended by OTP for the bulk of telecommunications areas.

Adoption of the metric system in the United States would improve the effectiveness of OTP in its communications responsibilities. The improvement, however, would be slight in that conversions would no longer be necessary. It is possible that the advantage in using purely metric terms may be outweighed in the transition period by the unfamiliarity with the metric system by the employees and users.

There may be a need for new or revised telecommunications policy in the future that may stem from metric system implementation. There may be changes in FCC rules and regulations for the same reason. There may also be the need for the FCC and OTP to develop new international policy in coordination with other Federal Agencies and the Department of State for the same reason, but none of these changes can be predicted at this time. OTP, therefore, does not foresee any major impact on its immediate mission because of the adoption of the metric system.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

If there were a planned national effort to increase metric usage, the impact on the ability of OTP to perform its mission with respect to its telecommunications responsibilities would be *trivial* to *moderate*.

What Action Should Be Taken? OTP believes that U.S. industry should not be forced to adopt unrealistic schedules for implementing the metric system. In some areas, it may be necessary to extend the transition period beyond 20 years. Such possibilities should be appreciated and appropriate exceptions made.

It appears to OTP that a change, today, to metric usage in electronics is apt to be more successful than at any other time. Electronics technology replacement today is at a much more rapid rate than it was 30 years ago. Then, one expected a particular equipment design to last 20 to 30 years. As late as 10 years ago, electronics equipment was replaced about once every 7 years. This change in the replacement rate was caused primarily by the invention of the transistor. Today with solid state and integrated circuitry, the replacement rate on electronic equipment design may well be closer to every 4 years. Even at this fast technology turnover rate, however, it may take 20 years to implement the metric system in electronics because the whole industry would not change over at the same time.

PRESIDENT'S COMMITTEE ON CONSUMER INTERESTS

Liaison Representative:

Charles R. Cavagnaro

Respondent — Internal Operations:

1. Committee Staff

Respondent — Consumer Affairs Area of National Responsibility:

1. Committee Staff

1. Mission of the President's Committee on Consumer Interests. The Committee was established to study plans and programs of Federal agencies affecting consumer interests, to make recommendations to the President on questions of policy relating to consumer affairs, to conduct studies of matters related to consumer interests, and to encourage and assist Federal agencies to accomplish effective coordination of plans and programs affecting consumers. The Committee is chaired by the Special Assistant to the President for Consumer Affairs.

2. Present Metric Usage. The metric system is not presently used in any of the Committee's work.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). The Committee does not foresee any special need to use the metric system in any of its activities in the foreseeable future. An evolutionary change toward greater metric usage in the United States will not likely cause any special problems for the Committee.

4. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric Measurement Units (Assumption II). Metrication under Assumption II would have very little impact, cost or otherwise, on the internal operations of the Committee, especially in view of the fact that the Committee is not a statutory body. The Committee has no direct cognizance over any laws or regulations which would have to be changed as a result of metrication. Thus, the agency would have a minor task in implementing the changeover to the metric system in its internal operations. The Committee staff does feel that metrication would improve its communication with international consumer programs and bodies; it does not foresee any unusual disadvantages to metrication as far as the Committee's internal operations are concerned.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). The impacts under this assumption upon the Committee would be identical to those under the prior assumption.

6. Conclusion. The Committee staff favors concerted action to increase the understanding and eventual use of the metric system. The metric system should be taught to a greater degree, formally and informally, at all educational levels.

Impacts of Metrication on Consumer Affairs

Present Metric Usage. In the opinion of the Committee staff, the metric system is used at the present time in less than one-quarter of all measurements within the consumer affairs sphere. However, there does seem to be a tendency toward greater usage of the metric system in the consumer area, with consumers increasingly aware of the metric system and tending to accept the system. Thus far, the impacts on the consumer affairs area from the increasing worldwide and domestic metric usage have been limited to those classified as *trivial.*[1] Consumers have accepted the changes so far without complaint.

Future Impacts of Metrication. If there is no concerted national effort to increase metric usage, the evolutionary trend toward greater metric usage will probably be accepted by the consumer.

If there were concerted national action to increase metric usage, the consumer should be able to accept the changes without undue complications, providing that there would be a transition period at least 10 years in length.

Adoption of the metric system would not likely affect the effectiveness of the Committee in dealing with consumer interests. The impacts of metrication on the ability of the Committee to perform its mission would be generally limited to those classified as *trivial.*

What Action Should Be Taken? The Committee staff believes that there should be increased educational programs, formal and informal, at all levels to increase the public's understanding and use of the metric system.

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[1] See "Classification of Intensities of Impact" scale on p. 79.

GOVERNMENT PRINTING OFFICE (GPO)

Liaison Representative:

Dan W. Willingmyre, Director of Engineering

Respondents — Internal Operations:

1. Finance and Accounts Division
2. Purchasing Division
3. Public Documents Division
4. Tests and Technical Control Division
5. Disbursing Office
6. Field Service Division
7. Plant Planning Division
8. Typography and Design Division
9. Personnel Division
10. Engineering Division

1. Mission of the Government Printing Office. The Government Printing Office (GPO) produces printing and binding services for Congress, the Executive Office of the President, the Departments and Independent Agencies, and the Judiciary. GPO also furnishes paper, inks, and similar supplies for the Federal Government, distributes Government publications, and maintains catalogs and a library of these publications.

2. Extent of Present Metric Usage. The metric system is now used in chemical, electronic, electrical, and other technical activities within GPO. Metric units are used in laboratory measurements on printing materials within the Tests and Technical Control Division. Some of the printing and binding equipment is of foreign manufacture and is made according to the metric system. Because of the present metric usage, apprentices at GPO are taught basic metric units and it is necessary to stock some metric supplies and tools. Most Divisions in GPO, however, do not use the metric system. The use of metric or non-metric units and standards within GPO is governed by those with whom GPO does business.

The primary advantage of using metric measures is that they facilitate international cooperation. Major disadvantages of present metric usage are preference by industry and the engineering profession for the customary system and lack of employee familiarity with the metric system. There are also cost increases and operational impairment because of interfacing difficulties.

3. Anticipated Changes If There is No National Plan for Metrication (Assumption I). Since GPO is a production operation, GPO has to comply with material and industrial standards as they are developed within industry and the trade associations. At present, GPO's metric usage is small and, thus, troublesome because of the problems of a dual system. Increased usage would eventually overcome these disadvantages. Limitation by "Buy America Acts" and non-metric usage by U.S. industry precludes acceptance of metric measures on a large scale by GPO unless the U.S. printing industry adopts the metric system or the Congress or government agencies demand metric usage.

None of the responding Divisions reports a foreseeable increase in metric usage. Some of the Divisions foresee problems in the increasing worldwide and domestic metric usage. These problems include: training, dual dimensioning, increased conversion, increased inventory, and increased interfacing. None of these problems will significantly affect GPO's operations, though.

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). During the transition period costs would be increased in some areas up to 10 percent, largely because of double stocking. A slight loss in production would result until existing equipment were replaced because of obsolescence or deterioration.

Metrication's heaviest impact would fall upon the Purchasing Division. During the transition, costs[1] would increase by $137,700 per year (under 1 percent) – $27,560 for machinery and equipment purchases, $89,390 for inventory storage, and $20,750 for machinery and equipment parts. The Plant Planning Division anticipates an added annual cost of $29,000 (or 5 to 10 percent) for planning during the transition period. The Personnel Division believes that retraining would lead to an annual cost increase of less than 1 percent ($5,000). The Engineering Division anticipates an increase in costs during the transition period of 1 to 5 percent – a $24,600 increase for shop equipment and $15,000 for parts and stores.

The Tests and Technical Control Division expects a net cost increase of about $600 per year during the transition period ($500 increased cost for revising standards, $500 increased cost for changing scales, and $400 savings because of simpler calculation). The Disbursing Office expects an annual cost increase of about $8,000 because of loss of efficiency on the part of personnel. The Field Service Division expects a cost increase of about $11,000 per year because of training expense and reduced efficiency.

Under Assumption II, GPO anticipates net savings during the post-transition period. The Purchasing Division anticipates an annual savings[2] of $27,540 (under 1 percent) – $5,510 for machinery and equipment purchases, $17,880 for inventory storage, and $4,150 for machinery and equipment parts. The Engineering Division believes that during the post-transition there would be a net savings of $1,500 for shop equipment and an increase in costs of $3,000 per year for parts and stores. The Tests and Technical Control Division expects a savings of about $400 annually because of increased efficiency. The remaining seven divisions expect no cost impacts after the transition.

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[1] This figure does not include annual cost increases of $186,375 for materials and supplies purchases, $1,375,580 for blank paper and envelope purchases, and $5,263,525 for commercial printing and binding purchases. These costs are added procurement costs as a result of temporary higher prices charged by industry to defray costs of metrication in industry. Since such cost increases are covered in the Manufacturing Survey part of the U.S. Metric Study, these figures are not included here in order to avoid double counting.

[2] This figure does not include savings of $37,275 for materials and supplies purchases, $275,115 for blank paper and envelope purchases, and $1,052,705 for commercial printing and binding purchases for the reason to avoid double counting as cited in footnote 1.

Under Assumption II, the GPO's direct costs would increase by about $230,000 per year during the transition period; there would be a cost savings of about $25,000 per year after the transition.

All but three of the responding Divisions believe that benefits would accrue to the GPO over the long term. Advantages of metrication would include: operational improvement, more effective promotion of U.S. standards internationally, improved international cooperation and communication, simplified calculations, and reduced errors. For example, easier computation, error reduction, and time savings would be inherent in such GPO operations as preparing scale of prices, pricing of receipts and issues for all inventory items, and platemaking. Computer programming would become more uniform and simplified. Several subdivisions predict cost decreases. Long range disadvantages cited are cost increases: these are anticipated by the Public Documents Division and the Personnel Division. The Typography and Design Division believes that disadvantages would predominate over advantages, because conversion would produce fractional measurements.

The advantages of metrication under Assumption II would outweigh the disadvantages according to the following six respondents: Public Documents Division, Finance and Accounts Division, Purchasing Division, Engineering Division, Field Service Division, and Tests and Technical Control Division. The disadvantages would predominate according to three respondents: Typography and Design Division, Personnel Division, and Plant Planning Division. The Disbursing Office is uncertain.

In order to implement the changeover under Assumption II, the Divisions would have to train employees, alter or recalibrate printing and binding equipment, convert or duplicate shop equipment, re-label and redescribe paper goods, change envelope and carton sizes, obtain dual inventories of stock, and enlarge or otherwise change storage facilities. The Typography and Design Division would have to change its tables of sizes and margins and some of its laboratory formulae. There would have to be changes in contractual documents concerning machinery and equipment and changes in equipment warranties. GPO would have to comply with changes in postal mailing regulations. There would be resistance to change on the part of the employees, but proper training should ease this situation. Time and labor would have to be spent in converting existing records. It must be emphasized, however, that the major impetus for a changeover would have to come from industry, if not from the Congress or government agencies.

5. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). Under this assumption, the impacts on GPO are practically the same as under the prior assumption. Costs, however, would be somewhat greater. For the transition period the Purchasing Division anticipates annual cost[3] increases of $275,425 (1 to 5 percent)—$55,125 for machinery and equipment purchases, $178,785 for inventory storage, and $41,515 for machinery and equipment parts. For the transition, the Typography and Design Division predicts an annual cost increase of $800 (or 1 to 5 percent), the Personnel Division foresees an increase of $5000 for retraining, and the Engineering Division expects a cost increase of $54,000 for training and engineering activities.

The Disbursing Office expects a cost increase of $8,000 annually because of loss of efficiency on part of personnel, and Plant Planning expects a cost increase of $29,000 per year. The Field Service Division expects a cost increase of $11,800 per year during the transition period—$11,000 for training and reduced efficiency and $800 for converting equipment. The Tests and Technical Control Division expects a net cost increase of $650 per year—$500 increase for revising standards, $500 increase for changing scales, $50 increase for converting packaging sizes, and a savings of $400 because of simpler calculations.

During the post-transition period under Assumption III, net savings are expected. The Purchasing Division believes that there would be an annual savings[4] of $137,700 (less than 1 percent)—$27,560 for machinery and equipment purchasing, $89,390 for inventory storage, and $20,750 for machinery and equipment parts. The Typography and Design Division believes that there would be an annual cost increase of $100 for engineering activities.

The Engineering Division expects a net added cost of $500 annually, or under 1 percent, during the post transition period. The Tests and Technical Control Division expects a savings of $400 per year because of simpler calculations.

Under Assumption III, the GPO's annual costs would increase by about $385,000 during the transition period; after the transition, GPO would experience a savings of about $140,000 per year.

The advantages and disadvantages accruing to GPO, the problem areas faced by GPO and the procedures used to implement the changeover under Assumption III are nearly identical[5] to those described under Assumption II.

6. Conclusion. There is a split in opinion within GPO on whether there should be a concerted national program to increase the use of the metric system. Five[6] of the 10 Divisions favor a program to increase use of metric measurement units and three[7] do not. Four[8] of the 10 Divisions are in favor of a program to increase the use of metric engineering standards while two[9] are not. The other responding Divisions do not know. Half the respondents believe that a 10-year transition period would be satisfactory. Three believe that a longer or shorter period would be better. The Purchasing Division believes that a 20-year period would be better since most equipment would have to be replaced through obsolescence. Both the Public Documents Division and the Tests and Technical Control Division favor 2-year transition periods since the shorter the transition period, the less time would be spent in the confusion of a dual system.

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[3] This figure does not include annual increased costs of $372,750 for materials and supplies purchases, $2,751,160 for blank paper and envelope purchases, and $10,527,050 for commercial printing and binding purchases for the reason as given in footnote 1.

[4] This figure does not include savings of $186,375 for materials and supplies purchases, $1,375,580 for blank paper and envelope purchases, and $5,263,525 for commercial printing and binding purchases for the reason to avoid double counting as given in footnote 1.

[5] It would probably not be necessary to change type sizes. The problems which would be involved in metrication at GPO are discussed in detail in a series of memos from the operating divisions at GPO to the Director of the Engineering Division in November and December of 1968.

[6] Finance and Accounts Division, Purchasing Division, Public Documents Division, Field Service Division, and Engineering Division.

The physical act of printing (making an impression or applying ink or dye to paper or other material) would probably not be significantly affected by any change in units of measurement. If standardized metric sizes were adopted by industry, however, metrication would affect the printing activity because press and printing equipment sizes are fixed and generally related to material sizes.

The impact of metrication on GPO under either Assumption II or Assumption III would be between *trivial*[10] and *moderate (closer to moderate)*.

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[7] Disbursing Office, Plant Planning Division, and Typography and Design Division.

[8] Finance and Accounts Division, Purchasing Division, Field Service Division, and Engineering Division.

[9] Plant Planning Division, and Typography and Design Division

[10] See "Classification of Intensities of Impact" scale on p. 79.

LIBRARY OF CONGRESS

Liaison Representative:

John F. Price, Head, Reference and Referral Section, Science and Technology Division, Reference Department

Respondents — Internal Operations:

1. Photoduplication Service, Administrative Department
2. Buildings Management Office, Administrative Department
3. Information Systems Office, Administrative Department
4. Preservation Office, Administrative Department
5. Division for the Blind and Physically Handicapped, Reference Department
6. Geography and Map Division, Reference Department
7. Prints and Photographs Division, Reference Department

1. Mission of the Library of Congress. Under law, the Library is, as its name implies, the Library of Congress. As such, its first responsibility is service to Congress. As the Library has developed, its range of service has come to include the entire governmental establishment in all its branches and the public at large, so that it has become, in effect, a national library for the United States. In addition to providing reference services for the public, the Library provides photoduplication services, books in raised type and "talking book" records, etc. for the blind and physically handicapped, and other services.

2. Extent of Present Metric Usage. Significant metric usage appears to be limited to five Divisions in the Library of Congress. The Photoduplication Service uses metric measurement units for length and mass in its photographic laboratory. The sizes of maps and atlases are measured in centimeters by the Geography and Map Division. The Prints and Photographs Division uses centimeters and millimeters to measure print sizes and gauges of motion pictures. The Division for the Blind and Physically Handicapped (DBPH) conducts product testing using equipment based on SI measurements. Finally, the Descriptive Cataloging Division measures the height of each book in centimeters (this Division did not participate in the Metric Study). These measurements are recorded on Library of Congress printed cards and in bibliographic publications available widely to libraries and the public.

The primary advantages of present metric usage are international cooperation and the fact that many scientific activities use SI. Certain operational improvements are noticeable in DBPH. It is interesting to note that the Prints and Photographs Division can obtain greater measurement accuracy using metric units. Lack of familiarity and duplication of effort are minor disadvantages.

3. Anticipated Changes if There is No National Plan for Metrication (Assumption I). The Library of Congress anticipates minor changes toward metrication in both measurement units and engineering standards. Although there would be some operational improvement, increasing worldwide metric usage would be the primary reason for change.

Under this assumption, the Photoduplication Service would require some retooling and specifications would have to be rewritten; these changes would result in a slight increase in costs (1 to 5 percent). DBPH would make some changes toward increased metric usage, but does not specify what these changes would be. The increased use of metric would increase training costs within DBPH by less than 1 percent.

If the Divisions do not increase metric usage under Assumption I, respondents foresee difficulties in dual dimensioning, in interfacing and converison, and in international cooperation (because of the increasing metric usage outside of the Library of Congress).

4. Anticipated Impact Under a Nationally Planned Program to Increase Use of Metric Measurement Units (Assumption II). Under this assumption the annual increased costs for the Library of Congress during the transition period would be insignificant. Only two responding subdivisions report any anticipated increased costs. DBPH anticipates an insignificant cost increase (less than 1 percent) because of changes in its testing and measuring activities. The Prints and Photographs Division anticipates a cost increase of 5 to 10 percent during the transition period, with an annual increase in costs of $10,000 for motion picture cataloging activities, $10,000 for print cataloging, and $1,200 for motion picture reference. During the post-transition there would be little or no additional costs within the Library. DBPH actually anticipates a cost decrease of less than 1 percent after the transition.

Following the transition period, certain operational improvements should be noticeable along with improved international communication. Photoduplication Service and DBPH believe that an additional benefit of metrication would be easier promotion of U.S. standards internationally.

In order to implement the changeover, certain cataloging rules and measuring devices would have to be changed. The Photoduplication Service reports that any dual system used during the transition period may have to be extended beyond 10 years. For other divisions, including the non-participating ones, conversion to metric terms could be made in most cases by the use of a single conversion table.

5. Anticipated Impact Under a Nationally Planned Program to Increase the Use of Metric-Based Engineering Standards as well as Units of Measurement (Assumption III). The impacts upon the Library of Congress under this assumption would be virtually the same as those under the prior assumption. The only significant exception would be greater costs for DBPH. In that Division, test and measurement activities would require an additional annual expense of about $5,000 during the transition, whereas under the prior assumption the increased expenditure would be insignificant.

6. Conclusion. All Library of Congress respondents favor a concerted national program to increase metric usage in both units and standards in the United States. A 10-year transition period is thought to be satisfactory.

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This publication reports the findings of a survey to ascertain the views of the civilian agencies of the Federal Government on the issues raised by the U.S. Metric Study Act. With regard to internal operations of the Federal agencies, the report covers present metric (International System of Units, or SI) usage and its advantages and disadvantages, expectations of future changes in measurement usage if the U.S. continues its laissez faire policy toward the SI, and attitudes toward a possible nationally coordinated metrication program. In the latter connection, the report contains estimates of added cost or savings impacts on agency internal operating budgets to be expected from a nominally 10-year planned metrication program, both during the transition and thereafter. The survey also assessed the impacts of metric usage and of its increase on the areas of responsibility of the Federal agencies in the society at large (e.g., communications, science and technology, health, labor affairs, international affairs and trade), and on the agencies' interfaces therewith.

17. KEY WORDS (Alphabetical order, separated by semicolons) Federal Government; International System of Units; metric conversion; metric system; metric usage; metrication; metrication, attitudes toward; metrication, costs and benefits of; metrication, impact of; SI; U.S. Metric Study

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